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Technical Association Meets At Boston

Paper And Pulp Industries Services To Country In Wartime Featured By Sessions On Packaging, Government Co-operation, Substitutions To Conserve Critical Materials—Those Attending.

[FROM OUR SPECIAL REPRESENTATIVE]

BOSTON, Mass., October 1, 1942—The paper industry as a part of the national war effort was clearly and elaborately portrayed at the fall convention of the Technical Association of the Pulp and Paper Industry when it met at the Statler Hotel, Boston, Mass., on September 29 to October 1, 1942. About 900 attended.

Good Local Committee

The meeting was sponsored and organized by the TAPPI New England Section in cooperation with the newly organized Maine-New Hampshire Group. Norman I. Bearse of the Champion-International Company was general chairman and was assisted by Frederick C. Clark, consulting engineer, W. E. Brawn of the Pejepscot Paper Company and Helen U. Kiely, American Writing Paper Company, as vice chairmen. Other committee chairmen included: Advisory—W. E. Kenety, Fitchburg Paper Company; Arrangements—R. H. Doughty, Fitchburg Paper Company; Entertainment—Fred. W. Schneider, Hampden Color and Chemical Company; Finance—W. L. Foote, B. F. Perkins Company; Ladies—Fritz K. Becker, Bird Machine Company; Program—L. B. Tucker, Crane & Company; Registration—H. T. Barker, Bird & Son, Inc., and Transportation—J. P. Kennedy, American Writing Paper Company.

Monday, September 28 was devoted to visits to nearby paper mills and industrial plants. Among the mills holding open house were Bird & Son, Inc., E. Walpole Champion-International Company, Lawrence; Falulah Paper Company, Fitchburg; Fitchburg Paper Company; Robert Gair Company, Haverhill; Tileston & Hollingsworth, Boston; Bird Machine Company, So. Walpole; Foxboro Company, Mansfield and Stowe-Woodward, Inc., Newton.

The TAPPI Executive Committee met at the Statler and other allied organizations held business meetings.

Meetings of Tuesday, September 29

WARTIME PACKAGING SESSION

The Wartime Packaging Sessions featured the entire technical program. These meetings were attended by an unusually large number, including a vast number of converting plant executives and technical men, many of whom had never previously been present at a meeting of the Technical Association. The vital interest in these sessions was made manifest by the important positions held by those who attended and the long distances many travelled to be present.

Arno W. Nickerson, consulting engineer and J. D. Malcolmson of the Robert Gair Company, presided at this session and devoted considerable preconvention time to organizing the well balanced program on packaging as well as the exhibit of packaging.

Ralph A. Hayward, President of the Technical Association and also of the Kalamazoo Vegetable Parchment Company was the first speaker and outlined the multitude of problems that now confront the paper and container industry. He cited ways in which technical men can meet the challenge offered through cooperation.

Chris. W. Browne, Editor of *Modern Packaging*, New York, N. Y., opened the symposium on packaging with his interesting talk on "Paper Has Some New Packaging Jobs." In this talk, Mr. Browne indicated the opportunities that are available to paper and container research men to supply packages and packaging materials to replace tin cans and other critical materials.

The next speaker was Arthur S. Allen, the well known consulting designer and colorist of New York City, whose work is familiar to everyone although probably only the executives of the companies selling certain canned and bottled goods know that Mr. Allen is the container designer. His creation of eye-appeal has led many to purchase one product rather than another because of the attention-getting value of the design. Mr. Allen, in his customary manner of presentation was able to illustrate his talk on "New Trends in Package Design" by showing large copies of the containers to which he referred. He showed and discussed the new container designs of Colgate, the Miles Laboratories, Beechnut, Reynolds Metals, Dobeckmun, Hinde & Dauch and others. He also covered some of the problems of packaging dehydrated foods.

A. H. Woodcock of the National Research Council, Ottawa, Ont., described some of the current packaging technical problems being considered in Canada.

Going from the general to the specific packaging problems, John F. Halladay of the American Coating Mills, Elkhart, Ind., discussed his important and fundamental paper on "An Engineering Approach to the Solution of Packaging Problems Involving Moisture Vapor Resistance." Moisture vapor testing methods were briefly discussed and their relation in perspective was appraised. He outlined a method for interpreting laboratory data from MVR membrane tests, based on mathematical considerations. He showed ways of evaluating closure efficiency, vapor stresses produced by the contained product and changes in the moisture content of the enclosed materials.

Tuesday Luncheon

To break the serious sequence of technical papers a recess was taken for luncheon. Following this the toastmistress, Miss Helen U. Kiely of the American Writing Paper Company introduced the two speakers. The first speaker was Leverett Saltonstall, Governor of the Commonwealth of Massachusetts, who discussed the problems presented by the war and congratulated those present for the opportunity they had to be of immediate and valuable service. The second speaker was Sr. Luis Mirauda, general manager of an imaginative mill in South America who told those present how paper was made in the "South American Way." He was finally unmasked and everyone was relaxed enough to proceed with the afternoon session on wartime packaging.

Wartime Packaging Session Continued

Many travelled long distances to hear the first speaker of the afternoon session, Capt. Robert R. Melson of the Subsistence Research Laboratory of the U. S. Quartermaster Corps in Chicago, who outlined some of the current "Ration Container Problems." Capt. Melson described the difficulties encountered in developing the new army ration packages, wherein paper is given the difficult job of replacing tin and to hold the contents in good condition to survive heat, cold, water, grease, humidity changes, rats, insect infestation and many other long shelf life difficulties. Capt. Melson asked for the intensive cooperation of paper and container tech-

TAKEN AT THE FALL CONVENTION OF THE TECHNICAL ASSOCIATION

nologists in solving the Army's problems regarding boxes, inner wraps, outer wraps and closures.

J. D. Malcolmson of the Robert Gair Company, New York, N. Y., reported the progress being made in providing "Folding Carton and Fiberboard Substitutes for Metal Containers."

The folding carton manufacturers are working on two developments for substitutes for tin containers, namely, a heat sealed bag inside a carton and a wax dipped carton. The fiberboard container is substituting for large size tin cans by the use of heat-sealed inner bags.

Following Mr. Malcolmson, A. E. Wendler of the Cellophane Division of E. I. du Pont de Nemours, Wilmington, Del., talked on the "Conservation of Metal and Rubber by Cellulose Sheeting." Remarkable progress has been made in the tin replacement problem solution. The new market for fibre containers and cellulose sheeting will undoubtedly survive in the days of peacetime operations ahead. Mr. Wendler stressed the need for establishing testing procedures that will accurately evaluate the services performed by containers made from cellulose products.

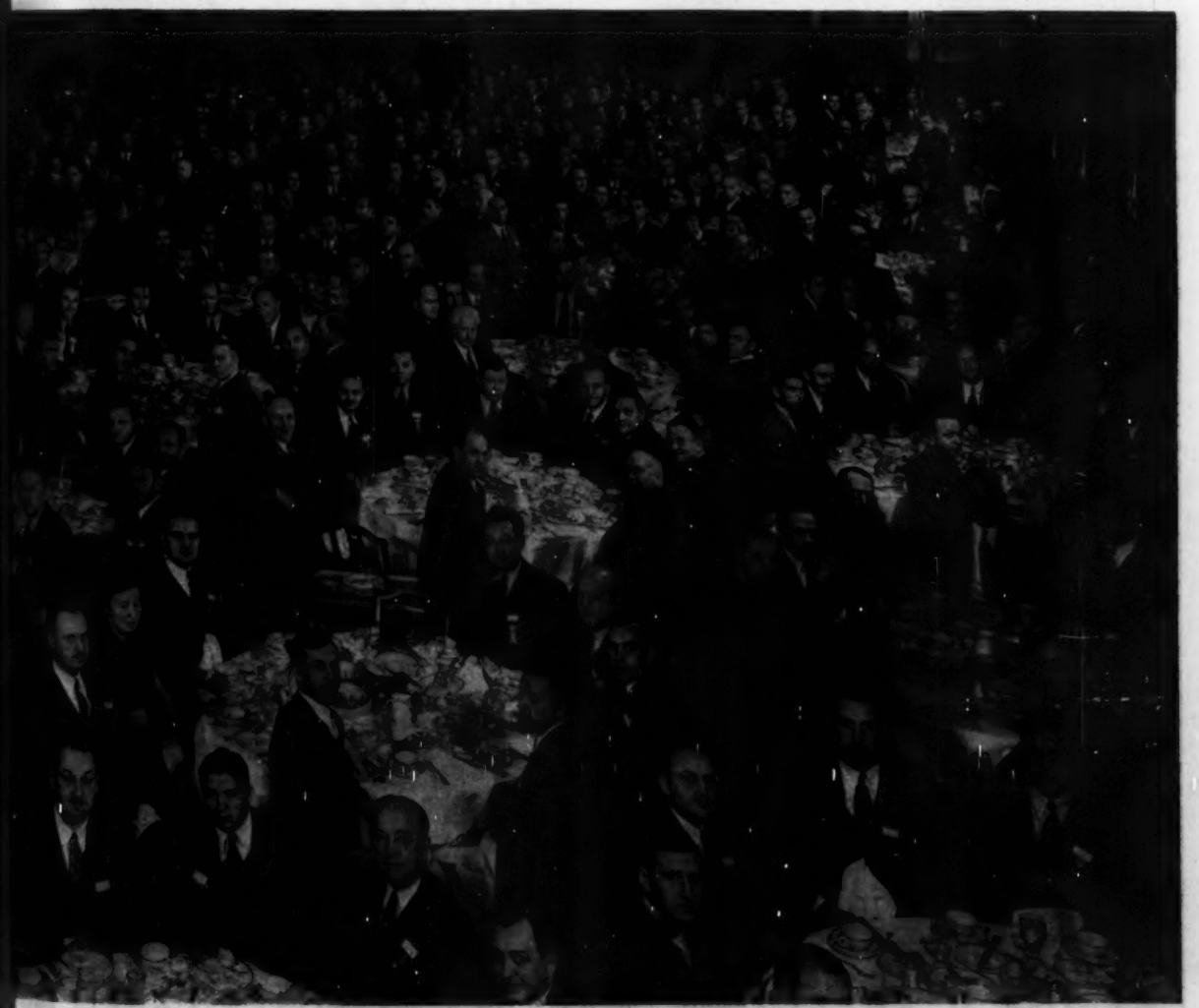
The final paper in this session was by Philip B. Taft of the Resinous Products and Chemical Company of Philadelphia. This was on "The Use of Urea Formaldehyde Resins for Waterproofing Starch Used in the Production of Solid Fiber and Corrugated Board.

At the end of this very full day devoted to the wartime need for new packaging materials everyone was ready to celebrate one of the great events that foreshadowed the American Revolution—the Boston Tea Party. Amid the melodious strains of accordion music the hundreds present enjoyed a tasty snack and a spot of tea and renewed acquaintances among the papermaking fraternity. This function was repeated on Wednesday afternoon.

Meetings of Wednesday, September 30

PAPER INDUSTRY IN WAR SESSION

As on Tuesday the sessions held on Wednesday were devoted to the important overall problems of the industry. In the morning W. H. Kenety of the Fitchburg Paper Company presided over a meeting held largely to bring together the men of the in-



OF THE PULP AND PAPER INDUSTRY, STATLER HOTEL, BOSTON, MASS.

dustry and the officials of the War Production Board in Washington.

This meeting was opened again by Ralph A. Hayward, President of the Association who talked on "Opportunities and Services of the Paper Industry in Wartime."

Following this Mr. Hayward presented C. Delderfield, an executive of a well known paper manufacurer in England who briefly discussed "The Wartime Paper Industry in Great Britain.

The program was then turned over to the Paper Branch of the War Production Board. T. Spencer Shore of the War Production Board made a short address on "The Future of Industry." He was followed by Arthur G. Wakeman who outlined "The W.P.B. Organization and Personnel" and by John Strange who led a discussion on "New Papers and Paper Products for War Needs."

Mill Organization in Wartime Session

Continuing the theme—What the Paper Industry Can Do to Help Win the War a session was devoted to a consideration of some personnel problems on Wednesday afternoon. This meeting was presided over by Wilbur L. Cassiday of the Hummel & Downing Company.

Three papers were presented at this meeting. A Catherine Davies of the Hammermill Paper Company discussed "The Role of the Technical Librarian in the Paper Industry." H. G. Noyes of the Oxford Paper Company talked on "Mill Personnel and the War Effort" and F. H. Frost of the S. D. Warren Company discussed how "Technical Departments are Meeting War Problems."

Meetings of Thursday, October 1

Four separate sessions were held on Thursday to discuss more detailed technical subjects.

Engineering and War Sessions

Roderick O'Donoghue, Chairman of the TAPPI Heat and Power Committee presided at the Engineering Session.

S. M. Bratton and F. M. Sanger of the Pusey & Jones Corporation described the "New P. & J. Flow Spreader." Currents, dead spots, accumulation of fibers resulting in flocculation, uneven distribution by the head box are claimed to be eliminated by this device which receives the stock at one point and by a hydraulic nozzle carefully designed distributes the stock evenly to the slice.

E. F. Burns, Chief Engineer of the International Paper Company discussed "Fuel Problems in Wartime." This was essentially a progress report on a long time project of the Technical Association. Coal storage was discussed at length not only from the size of inventory, but also from the proper storage methods and protection of piles against spontaneous combustion. Various economies were suggested regarding the reduction of steam plant load and cooperation with adjacent plants.

Power Teamwork for Victory was the subject of a very interesting paper by P. W. Swain, Editor of Power. This talk was a condensation of the material published by Mr. Swain in the September issue of Power. It was based on a thorough survey of the ways in which industries and communities are meeting the war situation through cooperation.

Two interesting papers on the use of synthetic materials to replace critical construction materials were presented. F. P. Hunsicker of the Westinghouse Electric & Manufacturing Company discussed "Laminated Plastics—One Answer to the Shortage of Critical Materials" and John A. Petho of the Continental-Diamond Fibre Company and Frank W. Vogt of Joseph T. Ryerson & Sons, Inc., talked on "Composition Bearing Applications in the Paper Industry. In many cases plastics are now serving where metals were formerly used such as in suction boxes, doctor blades, shake springs, grease lubricated bearings, chlorine gas piping, etc.

Miscellaneous Pulping Subjects

The Woodpulp Industry Wartime Projects

Since New England is not essentially a woodpulp producing region the session devoted to woodpulp dealt only with subjects that are of immediate wartime concern.

The chairmen of this session included Henry Perry of the J. P. Lewis Company, D. T. Jackson of the Hammermill Paper Company, Paul Hodges of the Crossett Paper Mills and D. C. Porter of the Kimberly-Clark Company, chairmen respectively of the TAPPI Mechanical Pulping, Pulp Purification, Alkaline Pulping and Acid Pulping Committees.

E. R. Schafer and J. C. Pew of the U. S. Forest Products Laboratory talked on the "Grinding of Hardwoods." In this paper the trend in the development of the use of this new raw material for groundwood was discussed.

Fred S. Hanson of the Kimberly-Clark Corporation reviewed the subject "Ethyl Alcohol from Sulphite Waste Liquor." Mr. Hanson pointed out that the only way of obtaining a large increase in the ultimate yield of alcohol is through the modification of the cooking processes to produce a waste liquor of high sugar content. This produces a pulp of low quality, but the practice is being carried on in Europe. Changes in sulphite mill equipment are necessary for the recovery of more than half the waste liquor. The process is somewhat marginal even in Sweden, but the pressure of circumstances has resulted in extensive development in that country. At present prices the process would be profitable in the United States but would not be economically sound after the war. For the same equipment from 6-10 times as much alcohol can be obtained from molasses. The potential alcohol production of the United States sulphite industry is estimated to be about 6% of the present total alcohol production, and to be capable of furnishing 3.5-4.5% of the planned production of synthetic rubber.

M. W. Bray and B. H. Paul of the Forest Products Laboratory read a paper on "Pulping Studies on Selected Hybrid Poplars. The yield by the sulphite process was found to be lower than for natural poplars. The bleach requirements were greater but the strength properties of the hybrids were superior.

F. Casciani and G. K. Storin of the Niagara Alkali Company presented "A Study of the pH Factor in the Hypochlorite Bleaching of Woodpulp, Part II. Two Stage Treatment of Sulphite Pulp.

F. A. Simmonds and E. L. Keller of the Forest Products Laboratory presented "Some Observations on the Problem of Iron in Bleaching Pulp." In this paper it was shown that both the chlorination and the hypochlorite stages, particularly the former, tend to remove iron from the pulp, but if water containing iron is used to wash the pulp it will reabsorb iron. Iron contents up to 0.15 ppm are considered to

Tribute to
TAPPI

Bird Machine Company is pleased to count itself among the many friends of TAPPI in this area who appreciate the honor of having the important wartime Fall Meeting here in Boston this week.

Let us take this opportunity to express our admiration and respect for the way in which the technical men and women of the industry are meeting the pressing problems of the present emergency.

As builders of equipment that shares the responsibility for the quantity production of good paper at low cost in virtually every North American mill, we are in a better position than most to appreciate the contribution to their industry and their Country that has been and is being made by the members of TAPPI.

Concentrating as we are, and as you want us to, on out and out war production, we are nevertheless prouder than ever to be identified with the paper industry and its Technical Association.

Whatever we can do to help TAPPI and its individual members now and in the years to come, we pledge ourselves to do.

BIRD MACHINE COMPANY
SOUTH WALPOLE, MASSACHUSETTS

be tolerable in washing water. Iron has an influence on pulp color.

J. E. Brennan and G. P. Vincent of the Mathieson Alkali Works gave a talk on "Bleaching Rag Stock with Chlorite Activated by Hypochlorite." This was a report on a considerably successful application in New England fine paper mills.

Water Conservation Session

Three papers were presented in a session devoted to water technology, a subject that has been of great interest to the industry in recent years.

Messrs. Miller and Sheen talked on "Process Water—New Developments and Conservation Measures." This paper reviewed the methods and equipment available for producing the required degree of purification by treatment of raw water.

Eskell Nordell of the Permutit Company discussed "Recent Developments in the Treatment of Water." In this paper reference is made to the Spaulding Precipitator and the Spiractor.

The final paper was by Howard W. Hall of the Dicalite Company who talked on "Diatoms in the Paper Industry." This paper referred to chemically treated diatoms and their effect on the physical properties of newsprint and kraft liner.

Tub Sizing Symposium

J. J. Thomas of the S. D. Warren Company conducted a symposium on tub sizing, a subject of great importance because of the future utilization of this process detail in the industry.

W. G. Hendricks of the Byron Weston Company talked on "Tub Sizing Difficulties." The following factors need to be considered: (1) The density of the unsized sheet, that is difference due to entrapped air in the fibrous web, preventing the size from penetrating; (2) Beater or previous sizing effectiveness over the sheet area; (3) Paper web moisture variations before entering the size tub, causing varying soak over the sheet area; (4) Solids per gallon in size tub area; (5) Viscosity due to temperature in the size tub; (6) Separation of the sizing liquid into jell and water, causing spotty sizing effects; (7) The texture of the press roll due to hardened films of sizing materials; (8) Web friction on carrying rolls in tub causing difference in absorption; (9) Speed at time of immersion; (10) Direct beating system causing degradation of size in some areas; (11) Circulation of the size in the tub; and (12) Evaporation of water in drying on an ununiform web.

R. G. Macdonald
Secretary-Treasurer

O. V. Simonson of Milligan and Higgins Corporation discussed "Hide Glue for Tub Sizing." In this paper Mr. Simonson outlined the steps in the manufacture of hide glue and pointed out that the essential points to watch in considering glue selection are fluidity, temperature, concentration of the sizing solution and type of paper to be sized.

E. P. Gillan of the Anheuser-Busch Company talked on "Enzyme Conversions." Mr. Gillan pointed out some of the difficulties encountered in corn starch conversion, due to its higher gelatinization temperatures and the properties inherent in grain starches. The corn starch granule is composed of alpha and beta fractions. The former is responsible for the high viscosity and gel formation of pastes cooked beyond

R. A. Hayward
President

V. P. Edwardes
Vice President

OUR HAT IS OFF TO TAPPI

Proud, we are, to have had a part in welcoming TAPPI to Boston this week!

The members of TAPPI are compiling a record of loyalty, resourcefulness and unremitting and unselfish effort that will be remembered and appreciated long after the wartime problems of the industry have been forgotten.

We look upon our long association with TAPPI members and the countless opportunities we have had to be of service to them with unending satisfaction. For the years to come in war and in peace, we can ask nothing better than to stand shoulder to shoulder with you.

Stowe-Woodward

THE RUBBER ROLL SPECIALISTS

Newton Upper Falls, Mass.

the gelatinization point while the latter presents a true colloidal solution of low viscosity and it will not gel. The function of the enzyme is to reduce the alpha fraction to a condition approaching, if not identical with the beta. This is accomplished by the liquification action of an enzyme to the exclusion of the saccharification. Careful control is required to get the best results.

R. B. Kerr of the Corn Products Refining Company commented further on "Starch for Tub Sizing."

Ralph T. Nazzaro of the American Resinous Chemicals Company, discussed "Synthetic Resin Emulsions for Paper Saturization." In this paper the author pointed out the benefit of extending rubber latex solutions with resins. Vinyl acetate polymers are claimed to be suitable substitutes for rubber latex. Their water sensitiveness can be improved by adding an acrylate, methacrylate or urea formaldehyde resin. Straight alloyed resins are poorer saturants and are superior to the vinyls only for water resistance. Properly plasticized resin sheets are superior to latex and/or reclaim. Reclaim sheets on the whole age better than latex sheets.

Institute of Paper Chemistry Papers

A number of papers were contributed by the Institute of Paper Chemistry. War activities prevented the presence of staff members to read and discuss these papers.

John H. Graff described "The Variable Angle Illuminator." A specially constructed microscope with its illuminator can be used for comparing surface textures of plane surfaces, square blocks, and cylinders without having to cut any sample of the materials to be compared.

Mr. Graff and B. L. Browning presented "A Chart for Speck Analysis." Identification of specks is determined by physical properties, solubility tests and chemical tests, making it possible to identify most of the specks occurring in pulp and paper and to determine the source of their origin.

William W. Marteny discussed "Fluorescence of the Extractives of Wood." An instrument was designed to measure the spectral character of extracted wood specimens and of the extracted materials. After the removal of fluorescent extractive materials from wood sections by successive application of various solvents, the fluorescence of the sections was characteristic for each of the woods studied.

Herbert W. Rowe prepared a paper on "The Nature of Fiber Staining by Iodine Stains." The staining of fibers by iodine stains is a colloidal phenomenon, involving the adsorption of iodine from various systems upon different materials. This reaction is influenced by any condition or substance that changes the nature of the adsorbed iodine such as particle size or by the nature of the adsorbent (hydration, etc.).

James d'A. Clark presented a paper on "The Measurement and Influence of Bonding Between Paper Fibers." The adhesion between fibers in a sheet of paper is dependent on the extent of fiber surfaces in actual contact, the strength per unit area of the joints, and the flexibility of the joints. Various indirect methods of measuring it were described as the shear and split adhesion tests.

Dr. Clark also had a paper on "Factors Influencing Apparent Density and its Effect on Paper Properties." In this paper some of the relationships for pulps are indicated. These include rigidity, bursting strength, tensile strength, tearing strength and lateral absorbency. These details will be covered in the paper when published.

Social Events

Throughout the meeting there were a number of social programs including a golf tournament at the Woodland Country Club, luncheons, a banquet, Boston Tea Parties and an unusually good ladies program, considering the transportation difficulties. Of special interest to women were fashion shows, bridge parties, tally-ho rides in the new horse drawn conveyances of the Gray Line, and a theatre matinee party. The final event of the meeting was the banquet at which Norman I. Bearse was the toastmaster and the principal speaker was Neil O'Hara, columnist of the Boston Traveler.

Papers in Technical Section

Many of the papers presented at the Convention will be found in the Technical Section of this week's issue of the PAPER TRADE JOURNAL beginning on page 79 and others will be printed in later editions.

Wartime Packaging Exhibit

To supplement the session on Wartime Packaging an exhibit was held in the lobby mezzanine of the hotel. The following exhibitors displayed samples of papers and containers showing how paper is doing an important job in replacing critical metals and other essential materials and in being the base material for many new products. These exhibits demonstrate the versatility of converters in meeting new commands.

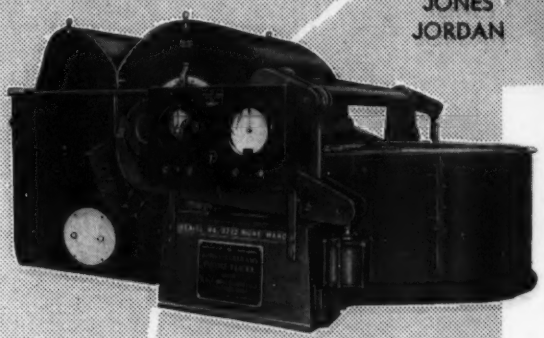
Arthur S. Allen, New York, N. Y., showed a number of new containers in mammoth size featuring products of the following companies: Burt Company, Buffalo, N. Y.; Miles Laboratories, Elkhart, Ind.; Reynolds Metals Company, Richmond, Va.; Riegel Paper Corporation, New York, N. Y.; Hinde & Dauch Paper Company, S. S. Pierce, Boston, Mass.; the Glidden Company (Durkee's products), Cleveland, Ohio; Kalamazoo Vegetable Parchment Company, Kalamazoo, Mich.; Robertson Paper Box Company, Nashua Gummed & Coated Paper Company, Nashua, N. H.; American Box Board Company, Grand Rapids, Mich. (weather-proof fiber box, cartridge case separators, coathooks, fiber frozen food containers, large carton); American Cyanamid and Chemical Company, New York, N. Y., (chemicals from wood such as wood turpentine, para cymene); American Reinforced Paper Company, Attleboro, Mass. (Sisalkraft Co.); American Writing Paper Company, Holyoke, Mass. (blue print paper); Angier Corporation, Framingham, Mass. (industrial wrappings).

Arden-Rayshine Company, Watertown, Mass. (paper bandages); Associated Business Papers, New York, N. Y. (industrial, consumer and dealer wartime advertising specimens).

Beacon Steel Products Company, New York, N. Y.

TO HELP YOU GET THE MOST SERVICE OF YOUR JONES EQUIPMENT

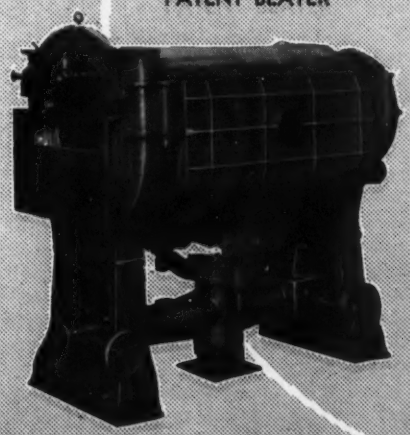
JONES JORDAN



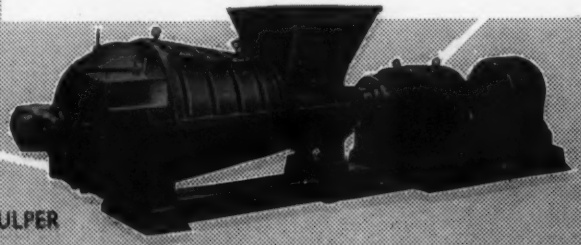
JONES-BERTRAMS PATENT BEATER

If Jones equipment in use in your mill is for the war economy, or not, proper maintenance is more important now than ever. If for the war effort, severe operating conditions demand avoidance of interruptions.

Jones' equipment require little care, because they are built to "stand the gaff." But with peak production, they may not get the little attention they need for maximum efficiency. For example: proper lubrication . . . examining and cleaning bearings at frequent intervals . . . replacing minor parts of equipment when worn, using alternate materials if necessary . . . and other conservation requirements that increase their service life. Accordingly, we are always ready to provide suggestions for "keeping them rolling" at continued, maximum efficiency.



JONES SCREEN



JONES PULPER

Jones

E. D. JONES & SONS COMPANY-PITTSFIELD, MASS.
Builders of Quality Machinery for Paper Mills

(sand distribution and cement forms).

Bemis Bros Bag Company (multiwall bags).

Bigelow-Sanford Carpet Company, Thompsonville, Conn. (paper mesh backing on rugs).

Bird & Son, E. Walpole, Mass. (flare paper, camouflage roofing and flooring materials, corrugated wooden frame boxes, weather-proof carton for service shoes and rubbers, concrete forms, shell containers, pressboard folders and guides).

Bloomer Bros., Newark, N. Y. (paper food pail).

Brown Company, Berlin, N. H.

Bulkley, Dunton & Co., New York, N. Y. (coated papers).

Chase Bag Co., Goshen, Ind. (paper shipping sacks).

Cleveland Container Company, Chicago, Ill. (3 inch British trench mortar carrier, 75 mm. shell cases, paper spools, small tubes treated with cosmoline, army ration can, 15 inch drum for lease-lend shipments of 75 lb. cheddar cheese, reported to be superior to veneer, waste paper basket, heavy cores, paper fire extinguisher, coin banks, cigar containers, tubes.

Curran Corporation, Malden, Mass.

Dard Hunter Museum, Massachusetts Institute of Technology (oriental papers).

Dearborn Chemical Company, Chicago, Ill. (chemicals).

Dennison Manufacturing Company, Framingham, Mass. (special papers).

Dewey & Almy Chemical Company, Cambridge, Mass. (thermoplastic coatings for dehydrated food and dried egg containers and ration packages, special paper closures for glass containers).

Downey Box Company, C. F., North Kansas City, Mo. (100 lb. fiber corrugated drums for asphalt, battery compounds and rosin; Du Pont Cellophane Div. (cellophane bags and liners, cans, food containers, pharmaceutical packages); Engineer Corps, U. S. Army, Boston Procurement District (shell cases and containers); Engineer Corps, Fort Belvoir, Va. (camouflage net garnished with paper strips; Fraser Companies, Ltd., Madawaska, Maine (package papers); Gair Co., Robert (tin cans, folding cartons, heavy fiberboard containers, dog food, coffee, mail, soup mix, vaccine, gear, ammunition boxes).

Gaylord Container Company, St. Louis, Mo. (cartons).

General Cellulose Company (Cellulose Wadding Products, Inc., Garwood, N. J. (paper hospital and household supplies, packaging material); General Felt Products Company, Brooklyn, N. Y.

Gillette Fibre Company, Boston, Mass.

Groom & Co., Thomas, Boston, Mass. (stationery and books).

Hill Packing Company, Topeka, Kansas. (1 lb. containers for horse meat).

Hinde & Dauch Paper Company, Sandusky, Ohio. (paper filing cabinet, hot water tank jacket, display cards, desk trays, large containers, waste baskets.

Holyoke Card and Paper Company, Holyoke, Mass. (coated papers for grease-proof containers).

Hummel & Downing Company, Milwaukee, Wis. (U. S. Army field ration K cartons, U.S.M.C. field ration D cartons, dried egg cartons for lease-lend shipments, food trays treated for grease resistance. coat hangers, frozen egg case, bag in box type, 50 lb. civilian lard pack, .090 weather-proof solid fiber container for shipment of U. S. Army field ration K., .100 weather-proof solid fiber container for shipment of 6 No. 10 cans of corn syrup, cooky caddies, spiral construction, for moisture resistance and grease resistance; Keuffel & Esser, Hoboken, N. J. (tracing, blue print, photostat, profile, graph papers and field books).

Keystone Roofing Manufacturing Company, York, Pa. (kraft water-proof paper).

Kimberly-Clark Corporation, Neenah, Wis. (photographic exhibit and samples of Kimsul and Kimpack, testing instrument packages).

Kupfer Brothers, Northbridge, Mass. (grease and moisture resistant coated paper for packages).

Lederle Laboratories, Boston, Mass. (pharmaceutical packages made of paper, formerly of tin).

Lithomat Corporation, Cambridge, Mass. (dry mat for printing).

Marathon Chemical Company, Rothschild, Wis. (Lignolite pressboard and other moulded products).

Massachusetts State Pharmaceutical Association, Boston, Mass. (drug store supplies).

Mead Sales Corp., New York, N. Y. (posters—"Paper is Vital."

Mitchell & Smith, Detroit, Mich. (gasket for cars, vacuum cleaner gaskets, water coolers, fire extinguishers and safety gasoline containers, tags).

Morley Button Company, Portsmouth, N. H. (moulded products).

National Adhesives Company, New York, N. Y. (cartons).

National Carbon Company, Cleveland, Ohio (containers).

Office of Civilian Defense. (pamphlets, posters).

Office of War Information (pamphlets).

Old Town Company, Old Town, Maine. (paper plates).

Ordnance Dept., U. S. Army, Boston Procurement District.

Paper and Industrial Appliances, New York, N. Y.

Paper Shipping Sack Association, New York, N. Y. (multiwall bags).

Patchogue-Plymouth Co., Holyoke, Mass.

Photopress, Inc., Chicago, Ill.

Plastic Coating Company, So. Hadley, Mass.

Quartermaster Corps, U. S. Army (photographs of army scenes, K and D ration packages, B unit and C ration tin cans, dehydrated vegetable packages—glassine inserted in metal bag which is inserted in solid fiber shipping case, sisalkraft box substitute for wooden box).

Reynolds Metals Company, New York, N. Y. (packages).

Ritchie Company, W. C., Chicago, Ill. (containers, fiber cans, transparent packages).

Robbins Paper Company, Boston, Mass. (paper tube, shell cases, moulded forms).

Robertson Paper Box Company, Montville, Conn. (containers).

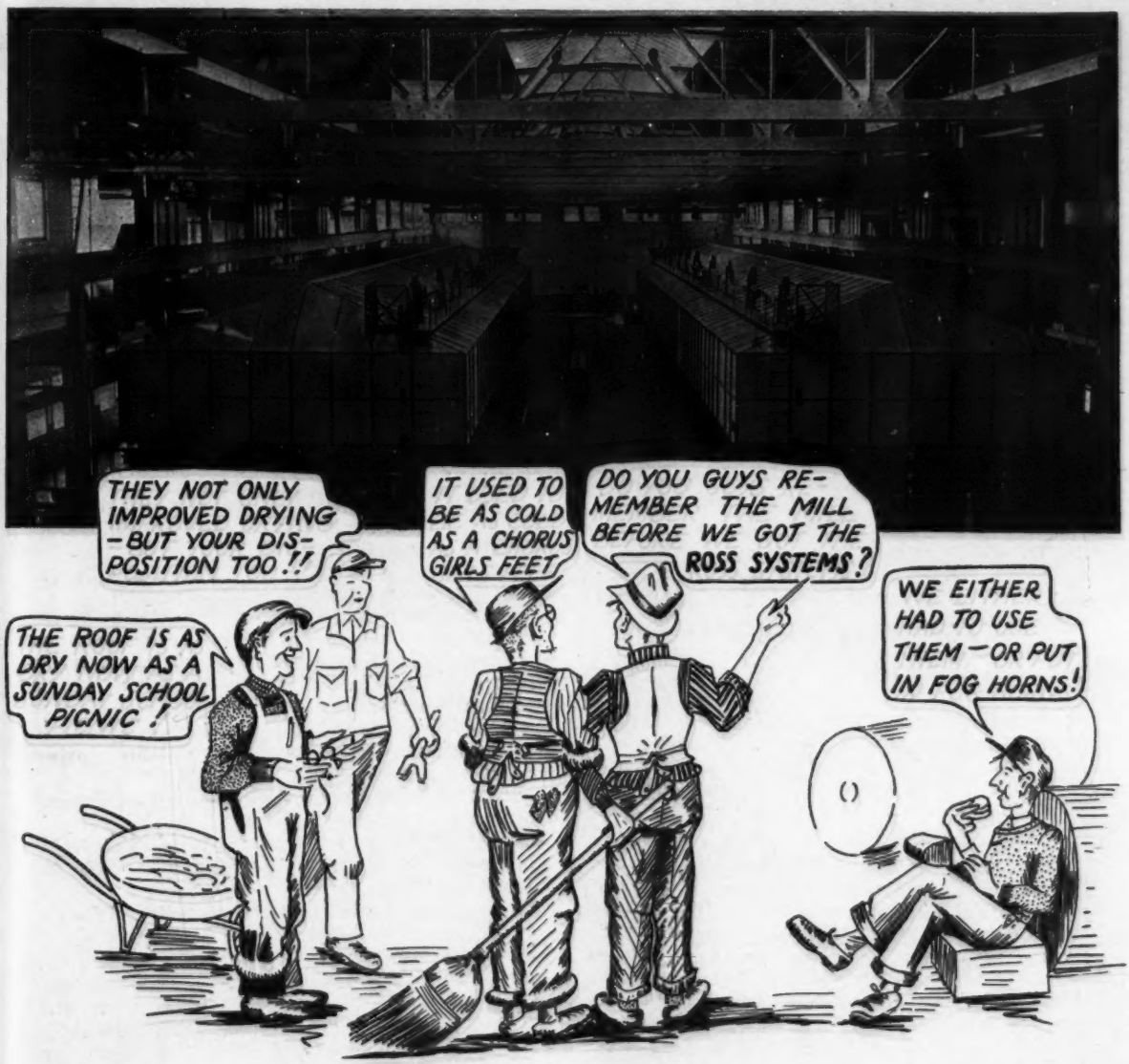
Rogers Fibre Company, Bar Mills, Maine (shoe counters and fiber grommets).

Royal Company, Thomas M. (cellophane liner coffee bags, freezing bag for Arctic trunk, prune package).

Sealright Company, Fulton, N. Y. (paper tobacco, cement, shortening, marshmallow, noodles, cleaning compounds, and frozen egg packages replacing tin cans).

Southern Kraft Div., International Paper Company, New York, N. Y. (100% Fourdrinier kraft shipping cases combined with water-proof adhesives).

Stein, Hall & Co., New York, N. Y., (containers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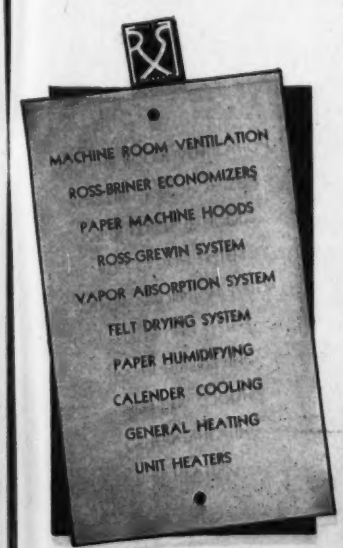

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The general theme of the Exhibit was The Paper Industry in Action—On the Battle Front, On the Home Front, In the Container Field—On the Medical Front—On the Industrial Front, etc.

Packaging of Dehydrated Foods*

By Charles Watson 3rd[1]

Abstract

Dehydration of foods was carried on to some extent during World War I, but the problems were not solved. Up until about five years ago this method of treatment lay dormant. When the United States became involved indirectly in World War II, considerable progress had been made in this method of processing food which removes moisture and reduces the weight and volume of the food.

Packaging materials for dehydrated foods must be moistureproof, greaseproof, light-resistant, insectproof, durable, and be susceptible to thermoplastic sealing.

The pulp, paper, and paperboard industry has many problems to solve with relation to dehydrated food packaging, but the industry has the engineers and other technologists, facilities, engineering and chemical laboratories to produce products to meet the demands of the dehydrated food industry.

Dehydration has been practiced to some extent for centuries and yet, paradoxically enough, it is only now beginning to show unmistakable signs of ridding itself of growing pains. I doubt if any other industry has followed a similar course. During World War I some individuals realized the advantages of shipping fruits and vegetables abroad which were concentrated as to weight and bulk. Unfortunately, the methods of processing at that time were both crude and haphazard. The products were not only unpalatable but disintegrated rapidly in storage. Following this experience dehydration disappeared except in the minds of a few persistent people who had not only vision but time on their hands with which to continue their experiments.

Approximately five years ago a few small companies quietly started in production against almost insurmountable odds. Money for new enterprises was almost impossible to secure due to the lack of past earning records, research was limited and the public was thoroughly uneducated to this new type of food.

At the start of World War II enough spade work had been done to convince certain government officials that dehydration merited enough consideration to start an extensive investigation of the industry. On December 7, 1942 dehydration came of age. The advent of the United States into the war and the resultant shortage of tin and boats gave rise to the necessity of drastic changes in food processing. In dehydrating, the removal of moisture in foodstuffs results in a shrinkage in volume and reduction in weight, both of which are advantageous in the fact of the present day transportation shortage in this country and on the high seas.

Problems to Solve

It has been authoritatively stated that the final success of dehydrated fruits and vegetables depends upon three factors equally important; the preliminary treatment of the products such as peeling, cutting, blanching, etc.; the actual dehydration process; and the packaging of the finished product.

This brings me to the matter at hand: packaging of dephydrated products. The containers for these products must be as foolproof as vacuum-packed tins have proved to be for the canning industry, but the problems are somewhat different. Packaging for the commercial market must be accomplished during the present emergency without use of the tin can. Thus far the greatest proportion of dehydrated foods in this market has been soup mixes, usually packed in envelopes holding from 1 to 3 net ounces. The problems here are myriad. *Packages must be moistureproof, greaseproof* if fats or oils are included in the mix, *light-resistant, insectproof, durable* enough to stand up under rough handling both in transit and in the retail store, and must be capable of taking a *thermoplastic seal.*

There have been various types of envelopes used, single cellophane No. 450 MSAT, duplex laminated cellophane No. 300 MSAT, and No. 450 MSAT cellophane laminated to glassine. These are the ones that we are most familiar with but I have noticed recently, and it is a healthy sign, that various other types are appearing in the market. In some cases the envelopes have been enclosed in a small paperboard box to give added protection and to offer better shelf display in the stores. All envelopes tested to date have not been moistureproof. We have found that no laminating agent is impervious to fats and oils over a space of time. In addition, envelopes tend to lack rigidity and become dog-eared after a short period on the shelves of retail stores. In some cases infestation has reared it's ugly head, and we have found evidence that various types of beetles have eaten into the bags.

We in dehydration can only tell you our problems. We believe that the pulp, paper, and paperboard industry is imbued with enough of the well-known American ingenuity to help us solve these problems. You have the facilities and technologists to study

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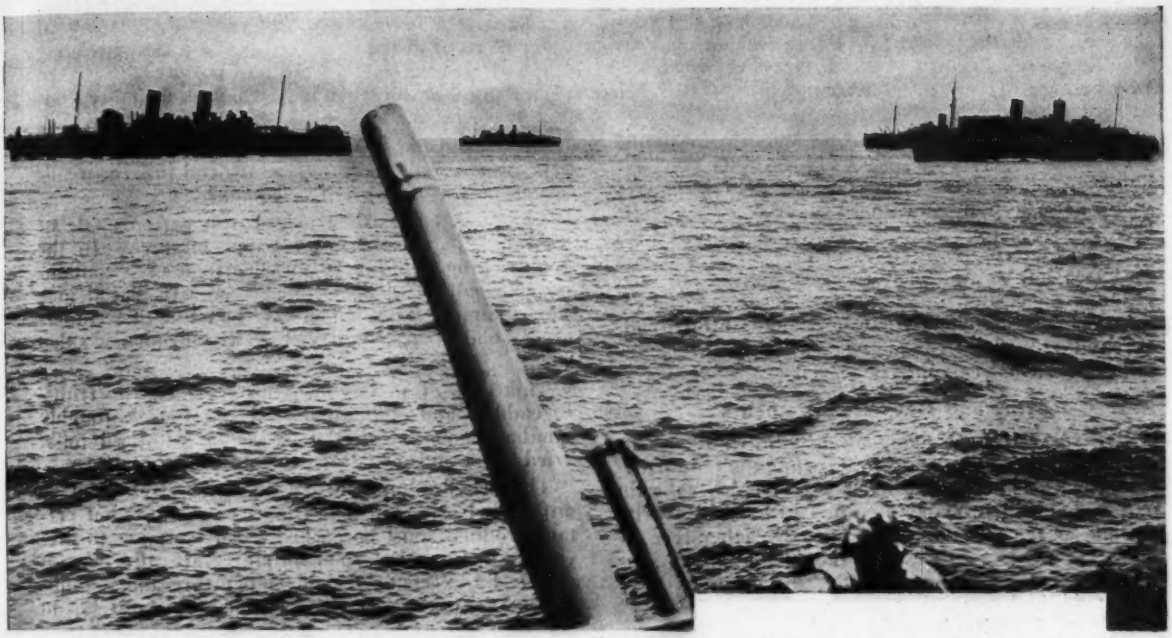
[1]President, Dry-Pack Corporation, New York, N. Y.



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these problems, the laboratories in which to test your theories, and the plants in which to prove your abilities. We have all lost previous weeks of production because of careless statement which were taken at face value, much to our regret.

I do not intend to take up your time by discussing the peculiarities of each soup and individual vegetable and how this pertains to the packaging problem. We in the dehydration industry must take it upon ourselves to acquaint you with these peculiarities when we meet your representatives in our offices and laboratories, but we do ask you to give heed to our suggestions, suggestions made only because we as an industry have discovered that it is only through adversity that we have conquered some of our problems. Other problems remain to be solved.

Army and Navy Requirements

Regarding the packaging of dehydrated foods for Army and Navy needs, up to this time the only package which has been extensively used has been the tin can and it will probably continue to be the favorite as long as the tin supply permits. No other type of container used or in prospect has all the advantages it possesses. However, recently, specifications have been published permitting the use of a new "3-in-1" container. This has been designed as a substitute for tin and other critical packaging materials. It is described as moistureproof, insectproof, and gasproof, and utilizes specially treated paper, fiber and wood. The new package is made of laminated paper, with two or more sheets of paper and lead foil fastened together with adhesive coatings that make them waterproof. A number of laminating agents including asphalt and wax have proved acceptable and the package under rigid service tests has met all expectations.

The first step in the packaging is the placing of five gallons of dehydrated food inside a laminated bag made of glassine paper. This primary package is then placed in a heavier main bag, which is moistureproof and insect-resistant.

On the outside of the main bag is a layer of *kraft* paper, laminated to a thin sheet of lead *foil*, the inside layer being a vaporproof *cellophane*.

The main bag is then placed in a carton made of solid fiber, a weatherproof paper mixture. In the final packing step, two of these cartons, each containing five gallons of dehydrated food, are placed in a single shipping case, which may be made of weatherproof solid fiber, or a nailed or wire-banded wooden box.

This type of package is only specified for fruits, vegetables, and soup mixes. I am not thoroughly familiar enough with the packaging of dried milk, dried eggs, and dehydrated meats to discuss them.

The dehydration industry does not want to make unfounded claims. For instance, we know that certain products must be packed in an inert gas to prevent oxidation, that some products are affected adversely by excessively high temperature and humidities. Again we place these problems in your lap to consider and study.

As regards the future, it is not beyond the realm of possibility that dehydrated foods are here to stay in the consumer market. We have reason to believe that soup mixes, individual packages of vegetables and desserts, eggs, milk, and dog food will vie with canned products in both consumer and institutional trade. The manufacturer must provide a satisfactory product but without completely satisfactory packaging the industry will continue to be known as purely a "war baby."

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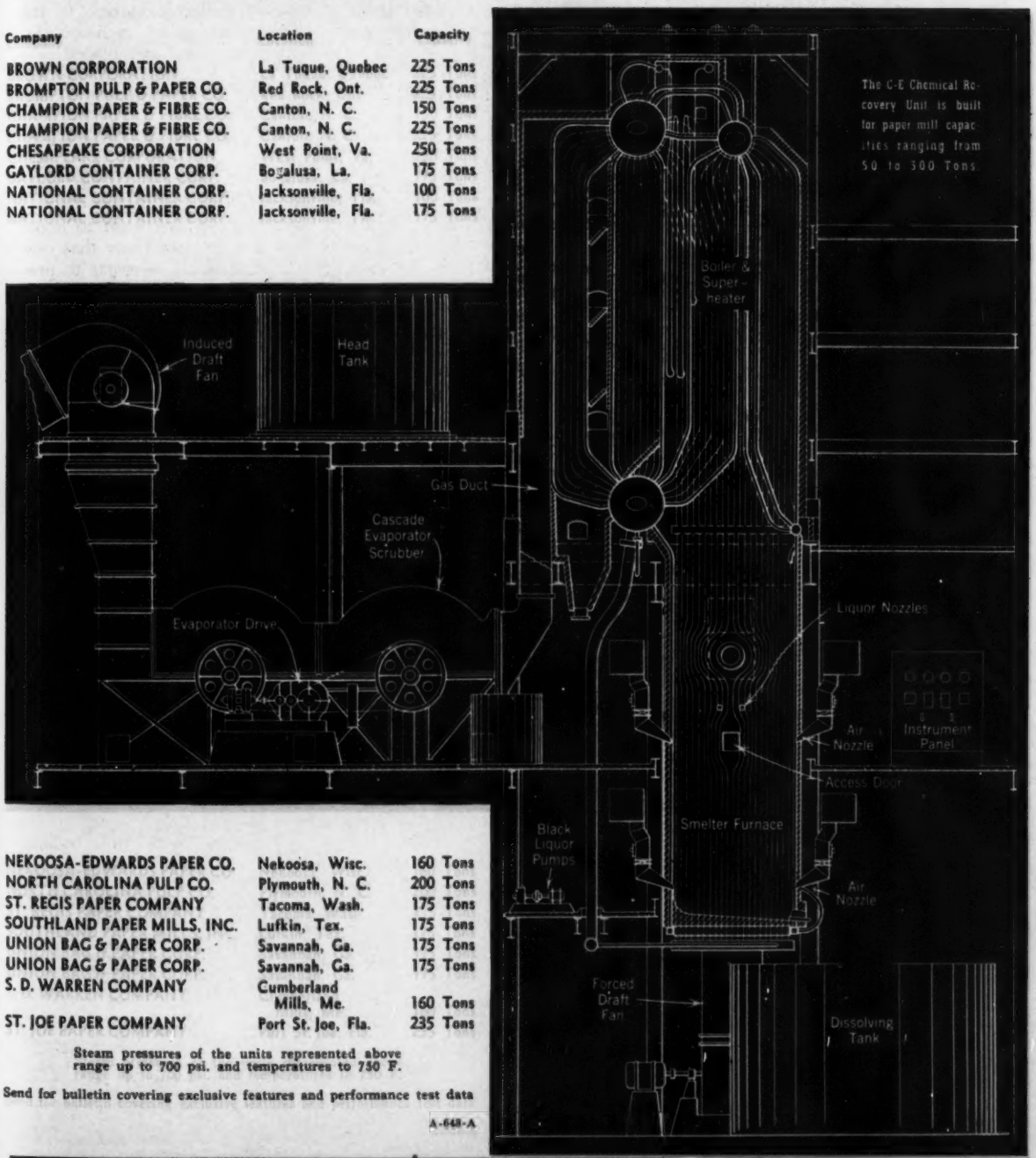

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T

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U

Mr. and Mrs. R. W. Kenneth Ulm and R. M. Upright.

V

H. L. Vanderberg, R. W. Van Kirk, J. V. Venturini, Carlo Vicario, G. P. Vincent, Joseph W. Viner, Henry Vranian and W. Gardner Very.

W

Justin P. Waite, H. P. Waldenmyer, Herbert G. Wales, A. K. Warner, Mrs. Poseph Waters, Mr. and Mrs. Vincent F. Waters, H. C. Webber, Karl F. Weikel, S. D. Wells, George Welp, Wright M. Welton, Herbert Wenberg, A. F. Wendler, W. B. Wescott, Harry E. Weston, R. W. Wheaton, William Bond Wheelwright, R. Cameron Whitney, R. R. Wiggins, I. L. Wilcox, Ralph A. Wilkins, F. M. Williams, Mr. and Mrs. Harry Williamson, John Willy, Hugh W. Wilson Sr., J. Alex Wilson, John D. Wilson, F. P. Winslow, H. Leighton Winslow, Jr., Anthony John Wirpsa, S. G. Witham, Dr. A. H. Woodcock, M. D. Woodruff, E. S. Worden, George A. Wright, Mr. and Mrs. J. F. Wright, W. A. Wylde, N. P. Wardwell, John Wentworth, Leslie A. West, R. E. L. Whelen, George E. Williamson, W. S. Wilson.

Y

C. J. Yarber, F. W. Yeager, Paul H. Yoder, C. Frederick Young and Vertrees Young.

Z

Frank Zeitlin and Henry C. Zeni.

Putting Employees' Ideas to Work

Production time cut, material saved, quality improved, waste utilized,—these are a few of the improvements resulting from suggestions by the men on the job in companies that provide a systematic basis for stimulating and encouraging employees to submit ideas. Some organized procedure for receiving, appraising and utilizing suggestions is essential today, particularly in companies engaged in war production.

As an aid to companies in introducing suggestion systems or in realigning existing plans to meet wartime needs more adequately, the Policyholders Service Bureau recently issued a report entitled "Suggestion Systems: Putting Employees' Ideas to Work." Based on an analysis of the suggestion systems of 34 companies with long experience in operating such plans, this report is designed to give a comprehensive picture of representative policies and procedures.

The report outlines the purposes of a suggestion system and the benefits which contributing companies have cited. Basic policies are described, followed by detailed discussion of clarifying policies adopted to eliminate weaknesses and avoid certain pitfalls.

Considerable attention is devoted to the matter of organization for the management and control of the suggestion system, including a description of the duties and functions of joint labor-management committees set up in response to the request from the Chairman of the War Production Board. Detailed descriptions are given of typical procedures followed in handling suggestion systems, as well as of the records commonly maintained.

Copies of this report are available to executives who address the Policyholders Service Bureau on their business stationery. Address: Policyholders Service Bureau, Metropolitan Life Insurance Company, One Madison avenue, New York, N. Y.

SYMBOL of FREEDOM

Silent and awestruck stood the early explorers and adventurers who dared the wilderness to gaze upon the great Falls at Niagara. And year by year in story and legend its fame grew—until Niagara became a symbol of a great and glorious new country. Free, untamed, resistless, it spoke in resounding tones of a land of far reaching spaces...broad rivers... tall mountains... fertile valleys... and boundless opportunities.

Like the river at Niagara, a stream of humanity broke away from its ancient, sluggish ways. It plunged into swift-moving rapids. It flowed through the hills and valleys of America. It built cities and farms, turned desert waste into rich farm lands, created mills and factories, gave birth to a new and better way of life for which we are all fighting and working today. And still this river of humanity flows on! The truth of its progress and its ideals are echoed throughout the world. And still Niagara flows on—symbol of the restless energy, the limitless abundance that is America.

We who work within sight and sound of Niagara Falls are devoting every ounce of our energies and facilities to speeding the flow of Chemicals for Victory.

CAUSTIC POTASH · CAUSTIC SODA
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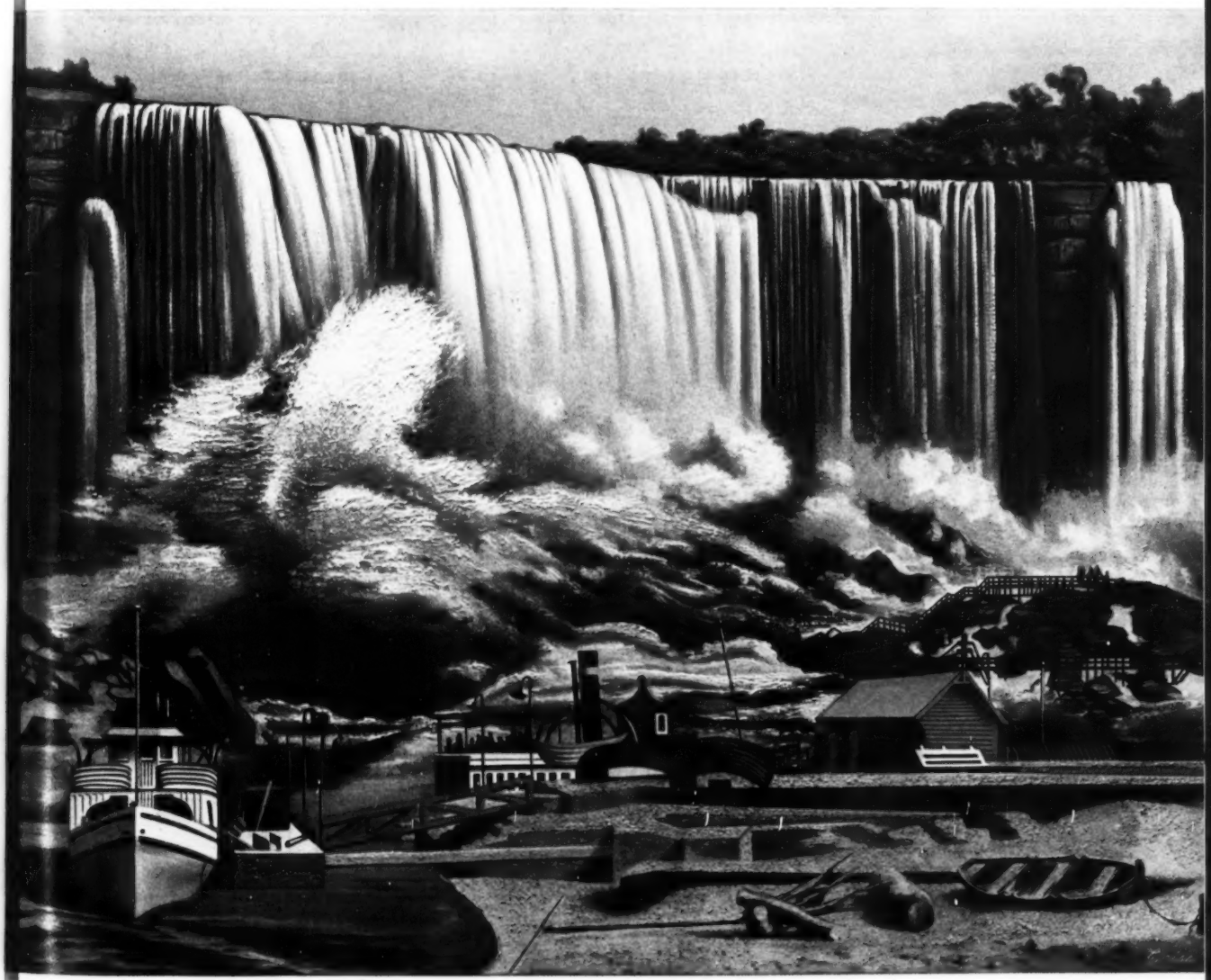
LIQUID CHLORINE

FROM THE ORIGINAL BY FRANCIS CRISS... IN NIAGARA ALKALI COMPANY'S COLLECTION OF PAINTINGS OF NIAGARA FALLS



NIAGARA ALKALI COMPANY

Niagara ALKALI COMPANY

60 EAST 42nd STREET, NEW YORK, N. Y.

Paper Sales Up Slightly in Midwest Area

Kraft and Book Papers Reported To Show Most Improvement In Wholesale Market—Waste Paper Demand Slow—Salesmen Resume "Football" Luncheons — To Aid "Hell-Box" Drive — Other News.

[FROM OUR REGULAR CORRESPONDENT]

CHICAGO, Ill., September 28, 1942 — The Chicago paper market continues to show slight improvement. No marked changes were indicated during the week but the tendency in almost every respect was toward strengthening. Prices showed little disposition to vary and evidenced firmness in certain grades. Kraft and book papers were reported to have registered the most improvement as decreased inventories forced buyers into the market. Some increase in retail sales also contributed to the betterment while local jobbers in the specialty business found fairly adequate preparations for one of the biggest holiday seasons yet. New uses helped to engender more enthusiasm in the box industry through the specter of "over-curtailment" still kept the market from a healthy condition. Groundwoods were reported as "just fair" while newsprints were also in the same category. Threats of lack of power and adequate employment combined to give the market a more bullish complexion than it has had for some months. Waste papers showed no change with collections still very adequate according to local merchants.

More Conservation and Paper Sales

Chicago paper merchants are wondering if the latest desire to trim "frills" from distribution will again result in a big drop in the demand for paper. Several Chicago retail executives are attending a Washington conference next week at which time request will be made to trim every non-essential service in order to curb retail buying further and also to make it more possible for distribution to live under price ceilings. The idea may have merit if limited to those "frills" which have actually some effect on the war effort. But Chicago paper distributors see in the effort the possibility that it will become another program to conserve the use of wrapping paper, gift wrapping, et cetera. Already Chicago outlets are "hide bound" to the policy of no special gift wrappings and trimmings for the holiday season and unwrapped packages are the "patriotic step." What will happen after more and more publicity is given to the elimination of so-called "non-essentials" is anybody's guess, say local merchants.

Paper Heads On Salvage Committee

The "Who's Who" of industrial salvage activity in Illinois was announced this week by the salvage committee of the Illinois Manufacturers Association. While designed to "increase the flow of scrap metal to steel mills," it contains a paper and allied products committee of which hard-working John D. Swigart of the Swigart Paper Company is chairman. Also featured is a Box Makers and Allied Products division headed by G. A. Vollmer of the Atlas Box Makers, Inc. Thirty-six industries are represented on the Chicago committee but why paper and box products are listed as aids in "increasing the flow of scrap metal to steel mills" has not as yet been clarified. Local commentators insist it's because the paper "scarcity" is still uppermost in too many minds.

Alton Co. Tries Own Campaign

The Alton Boxboard Company of Alton, Ill., is sponsor of a successful key collection campaign in that city which probably will have excellent patriotic results and also takes some minds off of "waste paper drives." E. P. Waterhouse, campaign chairman of the Alton Boxboard venture has announced that over 12,000,000 pounds of metal is the goal of the campaign and that responses to the collection have been very excellent. Containers are supplied by the company and placed in strategic spots where keys can be deposited and more than 300 containers are awaiting "key action". Thus the paper industry does a splendid patriotic job and directs energies in collecting the kind of waste and scrap that is really needed now.

Roach and Hopper Seek New Honors

Two widely known paper executives, both from Central Illinois, will be candidates for re-election as directors of the Illinois Chamber of Commerce at the annual meeting of that organization to be held in Chicago on October 9. They are C. E. Roach of the Capital City Paper Company of Springfield, and B. C. Hopper of the Hopper Paper Company of Taylorville. Both are from the Chamber's third district. Mr. Roach is also chairman of the important legislative commitee of the State Chamber and a member of its administrative committee. Retiring president of the organization is another executive well known to the paper trade, L. E. Leverone, former head of the Stein-Hall Company, makers of dextroses and starches widely used in the paper manufacturing industry.

Salesmen Go "Seasonal"

The western division of the Salesmens Association of the Paper Industry ushered in the 1942 football season on Monday, September 28, when the noon luncheons at the Sherman Hotel were transferred to the weekly Wailing Wall football luncheons in the same hotel. SAPEYES will enjoy the weekly appearance of football celebrities and then adjourn for brief business sessions immediately afterwards.

Fegert To Aid "Hell-Box" Drive

A. G. Fegert, well known paper trade publication writer, has been designated by the Graphic Arts Association of Illinois as a volunteer contact man to receive written reports on the "Hell-box" campaign to swell the scrap-metal campaign. A Hell-box brigade is to be organized in every printing and newspaper plant to go through every plant to scrap every piece of "scrappable" metal for deposit in the enlarged Hell-box. It will be Mr. Fegert's job to publicize the various reports, to stimulate interest among printers and newspapers and keep the "hell-box contributions" rolling.

Wood Pulp A Necessity in the War Effort

Canada Reports A Ready Market For Every Ton of Chemical Pulp Produced In Dominion Mills — Shipments To Great Britain Up 40 Per Cent Last Year — Contract Prices Remain Unchanged.

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., September 28—While plans are progressing for the diversion of electrical power from newsprint manufacturing mills in certain areas of Ontario, where there is a pending shortage of power for war industries, to plants more essential to the war effort, it is interesting to note the position of the manufacturers of pulp.

Chemical pulp is vital to the war effort because of its use in explosives and other necessary war materials and groundwood pulp is needed in large quantities for other essential products. There is a ready market for every ton of pulp that can be produced in Canadian mills.

Chemical Pulp Exports Increasing

Chemical pulps exported from this country last year amounted to 1,124,577 tons, which represents an increase of 30% over the previous year. Moreover, 1940 exports showed an increase of 61% over those of 1939. The aggregate value of the 1941 exports figures out at approximately $76 millions, nearly all of which was in U. S. funds. The 1940 exports amounted to $55 millions.

Groundwood pulp exported by Canadian mills to the United States during 1941 amounted to something over 200,000 tons, besides large shipments to Great Britain and other British Empire countries.

Canada's pulp trade during last year was, therefore, close to 1.4 million tons, or an increase over 1940 of about 40%.

Chemical pulp shipments from this country to Great Britain during 1941 showed an increase of 40% and the United Kingdom's wood pulp requirements are now about 24% of the prewar level. Canada and Newfoundland are supplying about two-thirds of the reduced requirements and the United States the balance. Virtually every Canadian company holds British contracts.

Thus Dominion and Newfoundland are the only sources of outside pulp supply for the United States and together they have been doing a pretty good job of meeting the requirements, as well as looking after British needs.

Outside of 13,210 tons of pulp imported from Finland last year, the United States depended entirely upon Canada and Newfoundland to supplement its own resources. Before the recent great depression these two countries supplied the United States market with about 700,000 tons of pulp of all kinds each year. During the worst years of the depression this dropped to nearly half the tonnage, the low point in 1932 being 425,326 tons. Last year the total pulp imports to the U. S. from her near neighbors had reached almost double the proportions imported in 1939, the figures being 1,131,790 tons.

Contract Pulp Prices Unchanged

The sharp advance in sales of Canadian pulps has not affected the price, constract rates remaining about the same during recent years. A move earlier this year to advance the price of chemical pulp was resisted, after study, by the O.P.A. in the U. S. Some adjustments were made respecting groundwood pulp and these have materially benefited the industry in this country.

With newsprint capacity operating at around 65%, it is not unlikely that some newsprint manufacturers may, if they are not restricted too severely in their use of power, pay more attention to the pulp business in the near future. Some of the newsprint mills with a surplus capacity for producing sulphite pulp and formerly active in the pulp markets, temporarily neglected this source of revenue last year during the acute demand for craft substitutes. Since that little flurry has subsided and future buying of newsprint has slackened, newsprint makers may be expected to again look into the possibilities of the pulp business.

In addition to these marginal producers, there are more than 20 Canadian companies regularly producing pulp for sale. Less than half of these depend entirely or chiefly on the sale of pulp, a few of the larger corporations have separate plants for the production of pulp. Of these companies classed as primarily pulp producers, only two are located in Ontario. Three are in the Maritimes, four in Quebec and one in British Columbia.

Abitibi and Other Large Producers

Abitibi Power and Paper Company is essentially a newsprint manufacturer, but is also an important manufacturer of sulphite pulp in Ontario. They have mills at Espanola, Fort William, Iroquois Falls, Sault Ste. Marie, Smooth Rock, Sturgeon Falls, Ontario, as well as other units in other Provinces. During the first half of 1942 Abitibi shipments of bleached pulp amounted to 60,792 tons. Some of this is groundwood pulp, the figures for which are not given separately. During the first six months of last year the figures for bleached sulphite pulp were 40,014 tons. During the entire year 1941 Abitibi produced 91,437 tons of bleached sulphite, as against 73,971 tons in 1940 and 45,819 tons in 1939. It is estimated that the sale of bleached sulphite pulp amounts to about one-fifth of the newsprint tonnage.

Other pulp producers in Ontario are the Howard Smith Paper Mills, Ltd., at Cornwall; Dryden Paper Company, Dryden; Ontario-Minnesota Pulp and Paper Company, Kenora and Fort Frances; The Great Lakes Paper Company, Fort William; Northern Ontario Power Company, Haileybury; Canadian International Paper Company, Hawkesbury; Spruce Falls Power and Paper Company, Kapuskasing; Alliance Paper Mills, Merriton; English River Pulp and Paper Company, Nipigon; J. R. Booth, Ottawa; Bronson Fiber Corporation, Ottawa; Provincial Paper, Port Arthur; Thunder Bay Paper Company, Port Arthur; Lake Sulphite Pulp Company, Red Rock; Beaver Wood Fibre Company, Thorold; Ontario Paper Company, Thorold; Thorold Pulp Company, Thorold; Welland Pulp Products, Thorold.

Heavy Rains Force Shutdowns in Some Mills

Wisconsin River Valley Manufacturers Hampered Last Week By Near-Flood Waters — Pulpwood Barges Are Wrecked — Consolidated Honors Employee—Cola G. Parker On Safety—Other News.

[FROM OUR REGULAR CORRESPONDENT]

APPLETON, Wis., September 28, 1942—Shutdowns were necessary at several paper mills in the Wisconsin River Valley a week ago when continued heavy rainfall caused a near flood stage. Although the flow reached 60,000 cubic feet per second for a few hours, a crisis was averted when the level began to recede.

The Wausau Paper Mills Company, Brokaw, Wis., was down for about three days due to difficulty in mixing colors in the dye department during flood conditions. Following a flood a year ago, the company sealed the basement of its mill against flood waters and averted a repetition of these difficulties.

The Ward Paper Company's mill at Merrill, Wis., stopped operations for part of a day as a precautionary measure when the Prairie River rose sharply. Part of the mills of the Marathon Paper Mills Company at Rothschild, Wis., was shut down until the river level receded.

The Consolidated Water Power and Paper Company, Wisconsin Rapids, Wis., made preparations to combat flooding part of its mills, but by opening sufficient gates at its dams was able to sluice the high water through without curtailing operations. Consolidated benefited by the unusual flow, however, because a start had been made on filling the reservoir above its big new Du Bay power dam near Knowlton, Wis. The level rose three feet within twenty-four hours. About seven more feet of water will be required to fill the head for which the dam was built.

Records kept by the Wisconsin Valley Improvement Company, Wausau, Wis., showed that 2,000,000 cubic feet of water were gained in the upper reservoirs of the Wisconsin River for the company's storage system.

Commission To Make No Power Changes

The Wisconsin Public Service Commission has declined to issue an order to the Whiting-Plover Paper Company, Stevens Point, Wis., to make water power changes which would benefit the Wisconsin River Pulp and Paper Company. The commission estimated the Whiting-Plover company would be obliged to spend $25,000 to prevent its pond from backing water into the tailwater of the Wisconsin River company's water power; also that the former would lose water power estimated to be worth $35,000.

Pulpwood Barges Wrecked

Two 250-foot barges loaded with pulpwood were broken up on the rocks along Lake Superior near Eagle Harbor, Mich., September 22. They were the City of St. Joseph and the Transport, and broke away from the tug John Roen in the heavy seas. All three vessels were operated by the Roen Steamship Company of Sturgeon Bay, Wis., and were bound for Port Huron, Mich., from Grand Marias, Minn. All members of the crews were rescued except the cook, Mrs. William McLeod.

In another accident September 21, a new pulpwood hauling truck owned by the Nekoosa-Edwards Paper Company, Port Edwards, Wis., crashed into a moving freight train of the Omaha railroad near Millston, Wis. The truck was loaded and was being driven by Ernest Wood, who hauls wood from the Jackson County area. Thirty-six cars of the freight and another on a siding were derailed. Wood suffered a broken nose.

Winners in Kimberly-Clark Golf

The annual golf tournament of Kimberly-Clark Corporation has been completed and the winners announced by Harold Krickard. The F. J. Sensenbrenner trophy was won by Robert Stark, who defeated Frank Lesselyong in the final match. Carl Nelson won over Tryg Lund to capture the S. F. Shattuck trophy. The Harry Price award went to Ned Hoeper who defeated Ronald Rodgers. Fred Hollinbeck possesses the Ernst Mahler trophy through his defeat of Ed Weitzel. The Kimberly-Clark Activities flight was won by Milton Remmel, who defeated Ray Otto.

Consolidated Honors Employee

Carl Anthofer, electrical worker who is retiring after twenty-four years of service with the Consolidated Water Power and Paper Company, Wisconsin Rapids, Wis., was tendered a party by his fellow workmen of Local 1147, International Brotherhood of Electrical Workers. He was presented with an electric clock inscribed with his service record, and a letter from George W. Mead, president of Consolidated, who commended his record of employment. Anthofer will receive a pension from the international union through his affiliation for twenty-one and a half years.

Nuptials in the Paper Industry

Bernard F. Shema, bacteriologist at the Institute of Paper Chemistry, Appleton, Wis., and Miss Audrey Childs, also employed at the Institute, were married September 22 at Sacred Heart church, Appleton. The couple will reside at 110 W. Harris St., Appleton.

Miss Anne Holtz, receptionists at the Institute, will become the bride of J. Lawrence Gray, Louisville, Ky., October 24, according to announcement made by Mr. and Mrs. Fred Holtz, the parents, last week. Mr. Gray attended the Institute and is employed by the B. F. Goodrich Rubber Company at Louisville.

Cola Parker Discusses Safety Problems

"Management's view of Safety Problems" was the subject of a talk given by Cola G. Parker, president of Kimberly-Clark Corporation, at a safety rally sponsored by workers of the company's Atlas mill at Appleton, Wis. The gathering was held at Conway hotel, Appleton, September 24. F. J. Sensenbrenner, chairman of the board, and William Hornbeck, former mill manager, were among the 120 persons present.

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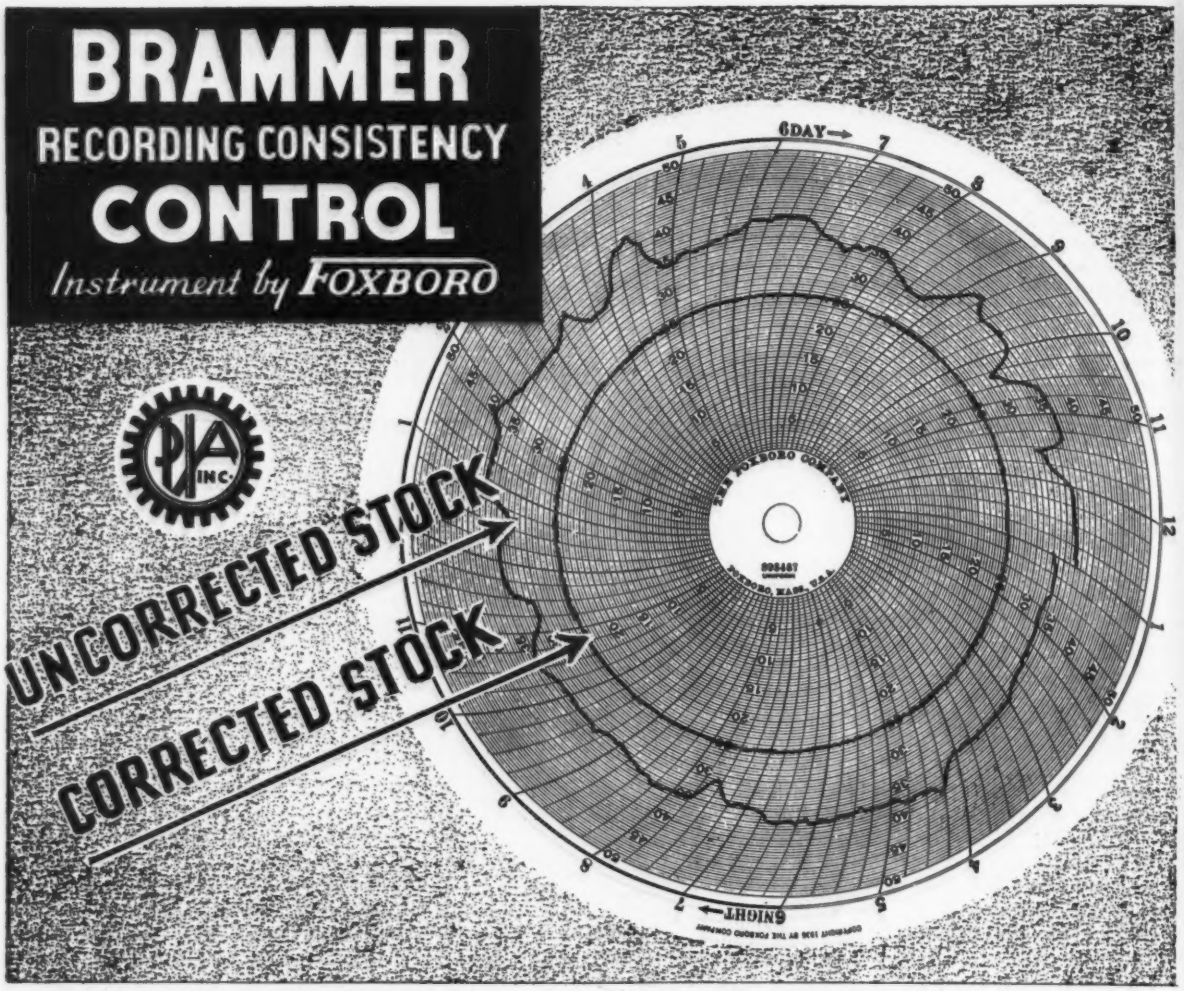
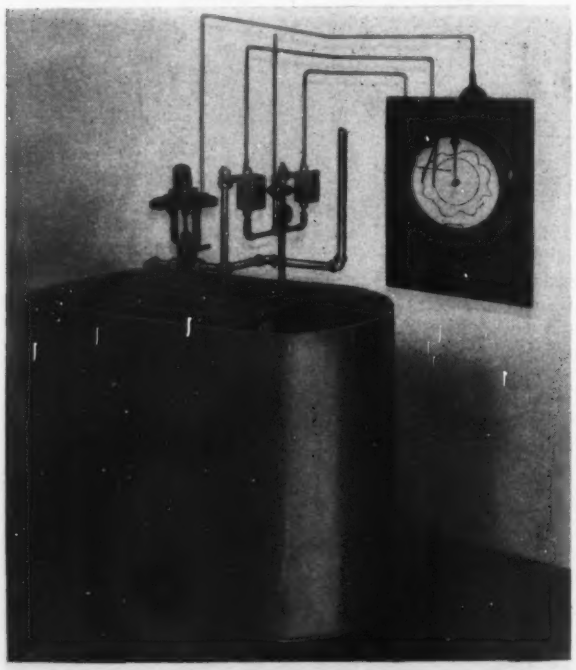


24-hour record chart, showing consistency before and after diluting water has been added.



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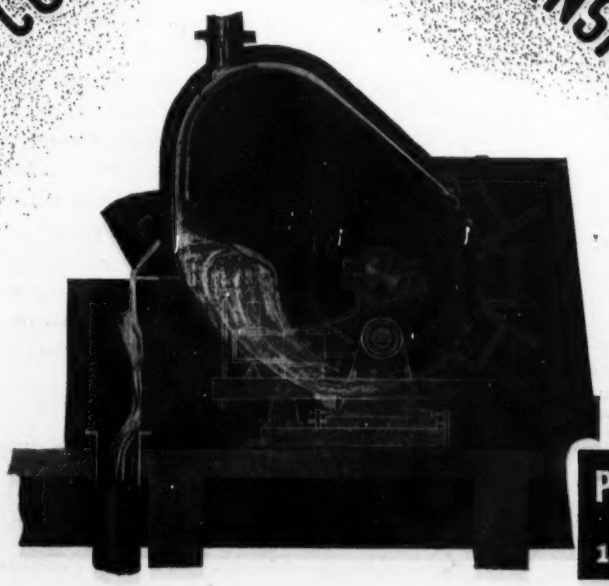

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Studies Wood For Production of Alcohol

Paper Making Interestings Survey Prospects of Increasing Output of Alcohol By Use of Wood Sugars—Waste Products of Paper Mills Reported Able To Supply 70,000,000 Gallons — Other Late News.

[FROM OUR REGULAR CORRESPONDENT]

MONTREAL, Que., September 28, 1942—Prominence is given in the press here to a despatch from New York stating that important paper-making interests are studying the prospect of substantially augmenting the vital wartime supplies of alcohol through use of wood sugars now wasted in the manufacture of paper. The despatch says a survey made by the paper companies show that from waste products the paper mills could produce a minimum of 70,000,000 of U. S. gallons of alcohol annually—or 70% of the additional alcohol capacity recommended by President Roosevelt's special committee on rubber. The reference is to the sugar contained in waste liquor from sulphite mills.

Long Been Subject of Study

This has long been the subject of study by the Waste Wood Committee of the Technical Section of the Canadian Pulp and Paper Association. A survey by the committee resulted in a report at the last annual meeting of the Association in which it was estimated that if wartime conditions made it necessary, Canada would be able to produce from waste sulphite liquor about 28,000,000 imperial gallons of absolute ethanol (spirits) per year. The possibility of using this in the manufacture of rubber was not then envisaged, the thought then being to use it as an admixture for gasoline to the extent of 10%. This would give an outlet for about 80,000,000 gallons of ethanol in Canada annually, or more than three times the production estimated possible from the Canadian pulp and paper industry. The main question to be solved is one of cost of production.

Advises Adequate Newsprint Stocks

The Wartime Prices and Trade Board, through John Atkins, administrator of printing, publishing and allied industries, has notified the Canadian Daily Newspaper Association that publishers of newspapers would be well advised to keep from 60 to 75 days' supply of newsprint stock on hand to assure supply "in the event of possible delivery difficulties, through increasing burdens on railroad transportation."

Wood Pulp For Explosives

Canadian Industries Limited, which manufactures explosives on a gigantic scale in Canada, reports that millions of dollars are now being saved annually in the manufacture of certain types of explosives produced in Canada through the utilization of Canadian woodpulp as a source of cellulose instead of imported cotton linters. It says that it is only since the beginning of the war that research and development has been undertaken to adapt wood pulp to the manufacture of nitrocellulose, the base for certain types of high explosives required for military purposes.

The use of cellulose-bearing wood pulps, quite plentiful in Canada, has not only eliminated the importation of cotton linters from the United States, thus effecting a considerable saving in foreign exchange, but has also considerably reduced the raw material costs without in any way impairing the quality or effectiveness of the resultant product.

One Plant Operating Over a Year

One Canadian wartime explosives plant has been operating on wood pulp for over a year, while two others have been using this domestic type of cellulose exclusively now for six months and two months respectively. Canada, therefore, is one of the first of the United Nations to adopt large scale production of military explosives from her own domestic supplies of chemical wood pulps.

Morris Gintzler Is Made Chairman

The Pulp and Paper Division of the New York and Brooklyn Federations of Jewish Charities, one of the oldest trade groups in that organization, held its first committee meeting recently to plan its campaign on behalf of 116 medical and social welfare agencies serving Greater New York.

Morris Gintzler, long active in philanthropic work again accepted the chairmanship of the Division, as plans were discussed for the forthcoming annual trade dinner to be held October 29th at the Hotel Biltmore.

Mr. Gintzler urged the fullest support to Federation this year, pointing out that this is a birthday year in which the two Federations are joining to mark New York Federation's 25th anniversary. "The best way our Division can celebrate the occasion is to develop plans to make this the outstanding effort in our long and useful Federation history," he said.

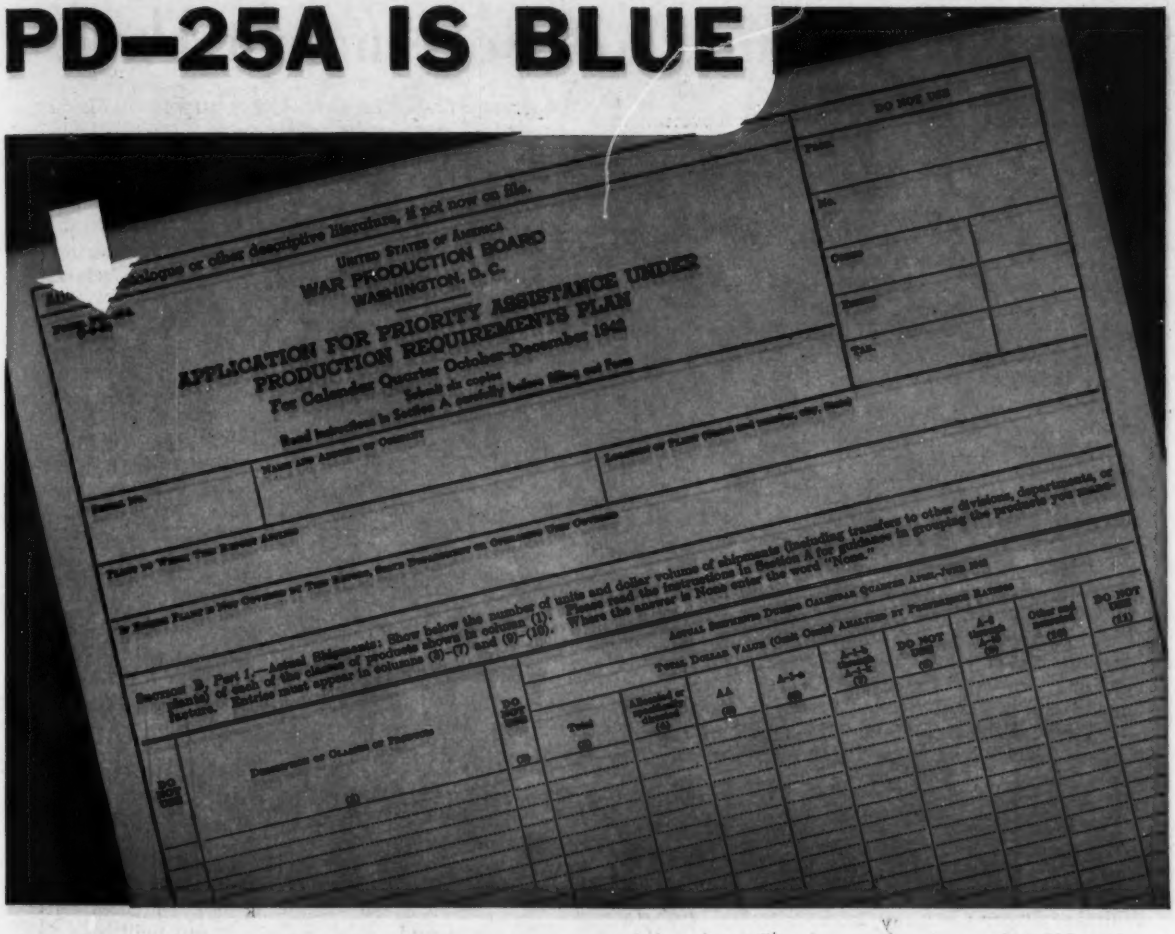
"Our country is at war to defend the democratic way of life. While doing all we can to hasten the victory, we want to safeguard at home the things like decency, kindliness and brotherhood without which victory would be meaningless," Mr. Gintzler concluded.

Plans are being drawn by the Pulp and Paper Division to honor its "25-year men"—those members who have worked and contributed to New York Federation ever since its establishment a quarter of a century ago.

Northwest Div. to Meet Oct. 17

The Northwest Division of the American Pulp and Paper Mill Superintendents Association will have a one day meeting on October 17, 1942 at Wausau, Wis. The program will begin with registrations and a business meeting consisting of a round table discussion at 10:00 A.M. at the Hotel Wausau. R. J. Kennedy of the Rhinelander Paper Company, Rhinelander, Wis. will be in charge. Luncheon at 12:30 where you will, bowling at 2:00 P.M. at the Elks' Club—prizes will be given, golf for those who wish. The dinner meeting will be held at the Hotel Wausau. There will be a speaker and entertainment.

PD–25A IS BLUE


UNITED STATES OF AMERICA
WAR PRODUCTION BOARD
WASHINGTON, D. C.

APPLICATION FOR PRIORITY ASSISTANCE UNDER PRODUCTION REQUIREMENTS PLAN
For Calendar Quarter October–December 1942

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INDUSTRY knows this Government form as "Application for Priority Assistance —," one of the examples of paper's part in carrying on the war. The use of paper for Government and business requirements and to replace critical materials makes it a most essential product.

The fact that "PD—25A is Blue" shows how color identifies an important form. In war as in peace, paper dyes are important for efficient handling of forms and messages and speedy transmission of vital communications. Dyes are also important for identifying many essential packages and labels.

The problem of utilizing dyes most effectively is a job for du Pont dyestuffs technicians. The services of those highly trained men are at your disposal to help you get the best results in colored papers and paper products.

E. I. du Pont de Nemours & Company (Inc.), Organic Chemicals Department, Dyestuffs Division, Wilmington, Delaware.

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Bids and Awards for Government Paper

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., Sept. 30—The Government Printing Office has received the following bids for 81,000 sheets 100% white M. F. printing paper, 29 x 41: R. P. Andrews Paper, 17.4 cents (per pound); Marquette Paper Company, 21.6 cents; Mudge Paper Company, 18 cents; Paper Corporation of US, 19.71 cents; Resolute Paper Products Corp., 20.7 cents; The Whitaker Paper Company, 16.54 cents; Wilcox-Walter-Furlong Paper Company, 23 cents; Collins Manufacturing Company, 27 cents.

For 100,000 pounds of 35 x 47 white offset book paper, bids per pound received were: Marquette Paper Corporation, 5.6 cents; R. P. Andrews Paper Company, 5.67 cents; Aetna Paper Company, 6.25 cents; Paper Corp. of US, 5.57 cents; Walker-Goulard-Plehn Company, Inc., 5.44 cents; Frank Parsons Paper Company, 5.75 cents; Cauthorne Paper Company, 5.6 cents; Bermingham and Prosser Company, 5.6 cents; North American Pulp and Paper Corp., 6 cents; Mathers-Lamm Paper Company, 6.79 cents.

For 39,900 pounds of 32 x 42 yellow sulphite writing paper, bids per pound received were: Paper Corp. of U.S., 6.55 cents; Walker-Goulard-Plehn Company, Inc., 6.4 cents; D. L. Ward Company, 7.19 cents; Stanford Paper Company, 6.83 cents; Cauthorne Paper Company, 7.15 cents, Marquette Paper Corp., 6.12 cents; Whitaker Paper Company, 6.83 cents; Mudge Paper Company, 7.12 cents; Central Ohio Paper Company, 6.41 cents; Eastern Corporation, 6.23 cents.

For 19,500 pounds of 32 x 42, 100% white manifold paper: R. P. Andrews Paper Company, 31.25 cents; The Old Dominion Paper Company, 25.974 cents; Bulkley, Dunton & Co., 35 cents; and the Whitaker Paper Company, 26.5 cents.

For 539,000 pounds of 36 x 50, 50% white lithographic map paper, bids per pound received were: D. L. Ward Company, 12.19—12.64 cents; Collins Manufacturing Company, 11.5—11.75—12—12.25 cents; Bermingham and Prosser Company, 9.986 cents; Bulkley, Dunton & Co., 10.75 cents; Bradner Smith and Company, 12.60 cents; Wilcox-Walter-Furlong Paper Company, 15.18 cents; Whitaker Paper Company, 12.44 cents; Walker-Goulard-Plehn Company, Inc., 11.17 cents; Stanford Paper Company, 16.5 cents; Perkins-Goodwin Company, 13.5 cents; Frank Parsons Paper Company, 15.18 cents; Paper Corp. of US, 12.39 cents; Marquette Paper Corp., 13.33 cents; Graham Paper Company, 12.17 cents; Butler Company, 9.89—9.99 cents; Barton, Duer & Koch Paper Company, 13.5 cents; R. P. Andrews Paper Company, 13.59 cents; and the Central Ohio Paper Company, 15.50 cents.

For 336,750 pounds of 30 x 50, 50% white lithographic map paper, bids per pound received were: D. L. Ward Company, 11.92—12.39 cents; Bermingham & Prosser Company, 9.986 cents; Bulkley, Dunton & Co., 11 cents; Whitaker Paper Company, 12.44 cents; Walker-Goulard-Plehn Company, 10.97—10.75 cents; Stanford Paper Company, 13 cents; Paper Corp. of US, 12.39 cents; Mudge Paper Company, 13.35 cents; Butler Company, 9.89—9.99 cents; R. P. Andrews Paper Company, 16.59 cents.

Cauthorne Paper Company has been awarded the contract for furnishing the Government Printing Office with 16,200 pounds of 25% rag yellow bond paper at $12.44 per cwt. Other paper awards just announced include the following:

Cauthorne Paper Company will furnish 31,000 pounds of 25% rag white ledger paper at $12.20 per cwt.; Marquette Paper Corporation will furnish 32,560 pounds of white sulphite writing paper at 6.44 cents per pound and 40,000 pounds of tan sorex paper at 10.50 cents per pound. Coy Hunt Company will furnish 33,150 pounds of 50% rag green index paper at $10.835 per cwt.; Mudge Paper Company will furnish 21,550 pounds of 50% rag cherry index paper at 10.83 cents per pound; Coy Hunt Company will furnish 33,150 pounds of 50% rag fawn index paper at $10.835 per cwt., the same company will also furnish 33,150 pounds of 50% rag salmon index paper at $11.185 per cwt., and 33,150 pounds of 50% ray buff index paper at $10.835 per cwt.

Mudge Paper Company will furnish 33,150 pounds of 50% rag cherry index paper at 11.33 cents per pound, and 17,500 pounds of 50% rag cherry index paper at 10.83 cents per pound; also 11,000 pounds of 50% rag cherry index paper at 10.83 cents per pound, 10,500 pounds of 50% cherry index paper at 10.83 cents per pound; 17,500 pounds of 50% rag buff index paper at 10.83 cents per pound, and 17,500 pounds of 50% rag salmon index paper at 10.83 cents per pound.

Further awards to the Mudge Paper Company include 11,000 pounds of 50% rag buff index paper at 10.83 cents per pound, and 11,000 pounds of 50% rag salmon index paper at 10.83 cents per pound, also 11,000 pounds of 50% rag green index paper at 10.83 cents per pound, 10,500 pounds of 50% rag green index paper at 10.83 cents per pound, and 11,000 pounds of 50% rag pink index paper at 10.83 cents per pound. The same company will also funish 17,500 pounds of 50% rag pink index paper at 10.83 cents per pound, 10,500 pounds of 50% rag salmon index paper at 10.83 cents per pound, 10,500 pounds of 50% rag pink index paper at 10.83 cents per pound, and 17,500 pounds of 50% rag green index paper at 10.83 cents per pound.

Marquette Paper Company will furnish 25,287 pounds of white sulphite writing paper at 6.44 cents per pound, and 29,700 pounds of tan sorex cover paper at 10.7 cents per pound; the same company will also furnish 10,000 pounds of Quaker drab cover paper at 6.94 cents per pound.

Cauthorne Paper Company, Inc. will furnish 11,640 pounds of 50% rag yellow index paper at 12.99 cents per pound, and 23,104 pounds of salmon sulphite writing paper at 7.12 cents per pound. Marquette Paper Corporation will furnish 2,647 pounds of white offset book paper at 10 cents per pound, and 20,800 pounds of white offset paper at 5.67 cents per pound.

R. P. Andrews Paper Company will furnish 16,362 pounds of artificial parchment deed paper at $26.95 per cwt.; Walker-Goulard-Plehn Company will furnish 252,582 pounds of offset book paper at 5.17 cents per pound; Paper Corp. of US will furnish 308,000 pounds of poster paper at 5.46 cents per pound; Whiting-Patterson will furnish 26,400 pounds of 25% rag yellow bond paper at 11.68 cents per pound. Bradner, Smith & Company will furnish 104,300 pounds of white super-calendered book paper at

SAVE VITAL TIME
. . . BUILD DURABLE CORROSION-RESISTANT EQUIPMENT with PENCHLOR ACID-PROOF CEMENT
Quick-setting • Self-hardening

Wartime needs demand time-saving wherever possible in acid-proof construction. Wartime pressure for the utmost in production means that corrosion-resistant construction *must* stand up. Penchlor Acid-Proof Cement meets both these requirements with a record of proved performance.

With Penchlor Acid-Proof Cement you can get brick-lined equipment into service without delay because this tough, long-lasting sodium silicate cement offers these advantages: Quick-setting and self-hardening—easily handled—no heating required—no drying delays—no acid treatment.

Continuous production is possible because Penchlor Acid-Proof Cement has proved itself in years of uninterrupted service. Great strength and minimum porosity reduce repairs to a minimum. The mortar set is permanent. There is less shrinkage with Penchlor Acid-Proof Cement. It is steam and water resistant. It adheres well to a wide variety of construction materials.

Industries Using Penchlor Acid-Proof Cement

Acids	Explosive	Pulp
Alum	Fertilizer	Rayon
Bleaching and Dyeing	Glass	Rubber
Chemical	Lacquer	Smelting
Coke and Gas	Leather	Spark Plugs
Distilling	Metal Pickling	Steel
Electrochemical	Oil	Tanning
Electroplating	Paper and Parchment	Textile

PENNSYLVANIA SALT MANUFACTURING COMPANY
Chemicals
1000 WIDENER BUILDING • PHILADELPHIA
New York • Chicago • St. Louis • Pittsburgh • Wyandotte • Tacoma

Where conditions require a cement of unusual strength and high resistance to abrasion, consider these Penn Salt *resin* cements: *Asplit*, for conditions always acid . . . *Causplit*, for alternate acid and alkaline conditions. These are easy to handle and will withstand a wide range of corrosive conditions up to 350 degrees F.

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At your service, without obligation, is the long experience of our engineers in handling acids and alkalis in our own plants. Write fully. Or if you prefer, use the coupon.

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COMPANY_____

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5.2933 per pound, also 106,400 pounds of white mechine-finished book paper at 5.046 cents per pound, and 102,000 pounds of white machine finish book paper at 5.046 cents per pound.

Marquette Paper Corporation will furnish 28,992 pounds of white sulphite writing paper at 6.04 cents per pound, and 68,495 pounds of white machine-finish book paper at 5.77 cents per pound. The Fitchburg Paper Company will furnish 177,525 pounds of safety sulphite writing paper for $21,484.20; and Cauthorne Paper Company will furnish 47,200 pounds of 50% buff ledger paper at 14.21 cents per pound.

Paper Men Consider Transportation

The largest industry traffic committee meeting on record was held Friday, September 18, 1942, at the Waldorf-Astoria Hotel, New York, by the American Paper and Pulp Association, when compliance by the industry with General Order ODT No. 18 was fully discussed.

The chairman emphasized that the paper and pulp industry was committed to a meticulous observance of this and all other orders of the Office of Defense Transportation, and the meeting evidenced an earnest desire to observe rather than to escape the terms of the Order so that our industry might make a maximum contribution to the cause of conservation of transportation.

It was recognized that compliance with Order No. 18 suggests the importance of determining standards for uniform industry-wide observance and specific suggestions, and problems of loading and handling of paper by leading grades under this Order were presented and discussed. Much valuable information to the end of careful observance of the Order was developed grade by grade from those present.

This, together with all additional information submitted by the industry, will be used to formulate recommendations as to standards for compliance with the Order by the industry. Accordingly, those attending the meeting and others addressed are invited to submit any information or suggestions based upon experience or experiment that will assist in determining these standards. Such information should be furnished to the following individuals who have consented to collect such data with respect to the papers with which their names are identified:

1. Printing and Writing Papers—F. F. Kator, the Mead Corporation, Dayton, Ohio.
2. Paper Board—C. L. Fenstermaker, Sutherland Paper Company, Kalamazoo, Mich.
3. Wrapping and Bag Papers—J. D. Patterson, Union Bag and Paper Corporation, Woolworth Bldg., New York.
4. Glassine Papers—J. D. Patterson, Union Bag and Paper Corporation, Woolworth Bldg., New York.
5. Newsprint Paper — H. Ignatius, International Paper Company, 220 E. 42nd St., New York.
6. Groundwood Papers, other than Newsprint — J. A. Quinlan, St. Regis Paper Company, 230 Park Ave., New York.
7. Tissues and other Light Weight Papers—A. A. Raphael, New England Paper and Pulp Traffic Association, Boston, Mass.
8. Boxes—C. L. Fenstermaker, Sutherland Paper Company, Kalamazoo, Mich.
9. Pulpwood—H. T. Ratliff, The Champion Paper and Fibre Company, Hamilton, Ohio.

William J. Bailey, chairman of the Traffic Committee Meeting, in his opening remarks said in part:

"We are invited by the War Production Board to write down our needs for transportation in our own terms, and it is my hope and my counsel to you men that we accept this invitation with courage, with resolve, and with a grim determination so to minimize our use of transportation that we will contribute substantially to the cause of conservation, and that we will be in a position to defend our needs for transportation in the adjusted war economy of the paper industry. The alternative of our accepting this invitation is that our use of transportation shall be regulated by priority, at the hands of objective people who could not possibly have very much regard for our industry standards, practices and relationships. Hence we have the opportunity ourselves of writing down our transportation needs, and I hope that we accept that invitation with real courage and determination.

Our industry must be put in uniform by the War Production Board, and the railroads must be put in uniform by the Office of Defense Transportation, because neither industry can waste the substance by which it is propelled. There must be maintained a reserve in transportation and transportation facilities if the war effort is to be successful.

I think the most selfish thing that any of us can do is to face these problems with courage and determination, and go the limit. All of this is said by way of introduction to our subject so that we might all understand that we are here, not to escape, but to observe and find means of compliance in a real, significant fashion with this General Order ODT-18, which will be the first subject on our agenda today.

This undertaking on our part today is principally for the purpose of gathering as much information as we can for later guidance in determining standards for the observance of this General Order ODT-18. We invited all parties of interest that were known to us, and suggested that they invite others, and it is very gratifying to see such a fine, representative meeting. I think this is not only the largest traffic meeting we have ever held, but the most important.

Our procedure shall be to develop as much information as we can from those who are experienced with respect to the loading and shipping of the products of our industry, and we shall treat our subject by grades of paper, and obviously we prefer that the men most informed with regard to those papers shall participate principally in the discussion."

Consult Your Local WPB Office

WASHINGTON, D. C., September 28, 1942—The War Production Board again urged businessmen that whenever they wish to obtain information from WPB they should go to their regional or field offices before coming to Washington.

"We have 12 regional and 127 field offices scattered throughout the country," the announcement said. "They were established in order to save businessmen the trouble of coming to Washington, and also to prevent an overload of work in Washington.

"When a businessman comes to Washington instead of going to his regional or field office he not only undergoes considerable expense and inconvenience himself, but also increases the burden on the men in Washington. Furthermore, the businessman can usually get quicker action in the field."

WAR EFFORT!

Moisture control is vitally important in packaging and containers.

Folding qualities of boxboard and paper.

Saturating and coating with plastics and other waterproofing.

Research work in the tempering of plastics.

The Williams Paper Moisture Tester is still the most rapid and accurate known means for the control of moisture in paper and board as well as heat treatment under thermostat control.

Rapid—Thirty samples per hour.

Accurate—Final weight taken without removal from oven—No chance for atmospheric moisture regain.

WILLIAMS APPARATUS CO.

WATERTOWN, N. Y.

BUILDERS OF FINE TESTING INSTRUMENTS FOR 25 YEARS

W. B. Killhour Goes to WPB

[FROM OUR REGULAR CORRESPONDENT]

PHILADELPHIA, Pa., September 28, 1942—W. B. Killhour, president of the Quaker City Paper Company, and a past prexy of the Paper Trade Association of Philadelphia, has obtained a leave of absence from his company to accept an appointment with the Inventory and Requisitioning Branch of the War Production Board in the Philadelphia Regional office, located at 16th and Pennsylvania Boulevard. Mr. Killhour has relinquished all his duties with his company for the duration of his services with the government. The business of the Quaker City Paper Company will be carried on with Howard W. Lee, vice president and sales manager, R. S. Reed, vice president and manager of the wrapping paper department, and Jean G. Killhour, secretary. The other officers and members of the staff remain as formerly: W. F. Killhour, treasurer, George J. Geiss, assistant treasurer, A. R. Williams, manager of fine paper department, R. L. Baker, assistant secretary, and R. G. Underdown, assistant manager.

Manhattan Rubber Wins Treasury "T"

Within one week to the day, employees of the Manhattan Rubber Manufacturing Division of Raybestos-Manhattan, Inc., Passaic, N. J., had pledged more than 10% of their pay for the purchase of War Savings Bonds, winning for their plant the first Treasury Department "T" to be awarded to a large factory in the Passaic industrial area. The percentage is expected to go higher when final returns are compiled.

The drive started September 14 with a rally attended by more than 3,000 enthusiastic employees and addressed by Manhattan men in the armed forces. It ended successfully on September 21.

Pledges to the company's pay-roll allotment plan, made by employees in June when the company was awarded the "Minute Man" flag for going 100% for Bonds, were increased to 10% or more of their pay through 200 Bond Committeemen, representing factory and office departments.

Manhattan's auxiliary plant in Whippany, N. J., also achieved 10% as the first plant in Morris County to reach that goal.

Peninsular Paper Co. Wins Pennant

YPSILANTI, Mich., September 28, 1942—Another of Ypsilanti's industrial concerns has received recognition of its efforts towards the voluntary purchase of war bonds it was learned, when the Peninsular Paper Company received from the Treasury Department certification of their having over 90 per cent participation in the war bond payroll deduction plan.

A United States Treasury Minute Man flag, and a new American flag have been ordered for the company, and are expected within a few weeks. Upon arrival of the flags, and for the initial flag raising, appropriate ceremonies will be planned.

A concentrated drive throughout the entire company has been waged, under a committee of the local 673 AFY-UAW, resulting in a participation of over 90 per cent for plant employes, and 100 per cent for office workers. Working on this committee were: Mrs. Inez Leavey, Karroll Aungst, Miss Kathleen Spencer, and Mr. and Mrs. Armand Pepin.

Obituary

J. Munson Gamble

J. Munson Gamble, founder and former owner, president and treasurer of the Brownville Board Company and an organizer and former officer of the Brownville Paper Company, died September 25 at his home in Watertown, N. Y., at the age of 76.

Mr. Gamble, a former member of the Watertown Board of Education, was an elder of the First Presbyterian Church, had served as trustee of the House of the Good Samaritan, and director of Watertown Community Chest, Watertown National Bank and Jefferson County National Bank.

He had been connected actively with the manufacture of paper since 1891, when he entered the employ of C. R. Remington & Sons, for whom he worked in the Harrisville area in charge of lumbering and surveying operations. In 1892 with Charles H. Remington, he organized the Brownville Paper Company with Mr. Remington as president and himself as secretary-treasurer. Their site had been a cotton mill since 1814.

In 1901 Mr. Gamble, with his brother, C. W. Gamble, organized the Brownville Board Company and established one of the most modern mills in the Black River Valley.

Lieut. G. H. Mead

WASHINGTON, Sept. 24, 1942—The death of Lieutenant George Houk Mead Jr., Marine Corps, during the offensive against the Japanese in the Solomon Islands on Aug. 19 was announced by the Navy Department today. Lieutenant Mead was a son of George H. Mead, a member of the National War Labor Board and president of the Mead Corporation of Dayton, Ohio.

According to dispatches, Lieutenant Mead, accompanied by one private, was scouting enemy positions when the private was fatally shot by a Japanese sniper. Bending over to give aid, the lieutenant was mortally wounded. Before his death he killed the sniper with his service pistol.

Lieutenant Mead managed the football eleven at Yale, played on the ice hockey team and was a varsity baseball catcher. In his senior year he captained the polo team. A top ranking polo player, he participated in the national championships at Meadowbrook, L. I., and was rated as a four-goal man.

Edward H. Thomas

Edward H. Thomas, manager of New York office of the Farrel-Birmingham Company, Ansonia, Conn., and Buffalo, died at the Presbyterian Hospital in Pittsburgh on September 13, following a heart attack.

Mr. Thomas was born in New York City, July 1, 1886. He received his early education in the public schools of East Orange, New Jersey, and graduated from Stevens Institute of Technology with a degree of Mechanical Engineer.

After graduation he became engaged in the sugar industry in the design, erection and operation of sugar factories in Puerto Rico, Cuba, Santa Domingo, Louisiana and the Phillipine Islands. In March, 1926 he became affiliated with the Farrel-Birmingham Company as sales engineer and manager of the company's New York office.

During the first World War he served in the Ordnance Department supervising the manufacture of T.N.T. In the years of the country's maritime expansion preceding and during the present World War he was active in the sale and installation of gear drives in many types of commercial and Maritime Commission ships.

Mr. Thomas was widely known in both the cane sugar and marine industries as an experienced and capable engineer with a broad knowledge of the design and operation of the equipment used in these fields.

He is survived by his wife, Mabel Sykes Thomas; a daughter, Jean, senior at Wellesley College; two sisters and two brothers. He was a member of Hope Lodge No. 124, F.&A.M., of East Orange, N. J.

Funeral services were held September 17, from The Colonial Home in East Orange, with interment in Rosedale Cemetery.

Five Year Club Has Party at Canton

Between 500 and 600 employes of the Canton division of the Champion Paper and Fibre company tonight attended the five-year continuous service group party in the Canton armory with Reuben B. Robertson, Sr., executive vice-president, as host September 19.

Before presenting service awards to the more than 150 new club members who became eligible for membership as of last January 1, Mr. Robertson praised the genuine spirit of cooperation of Champion employes and said that during the present emergency continued cooperation is essential on the part of all in the effort to bring about complete victory.

H. A. Helder, plant manager spoke briefly before presenting Mr. Robertson. Mr. Helder welcomed all members of the five-year service club.

R. C. Looper, an employe of the company's electrical department and secretary of the Champion mill council, responded for the guests.

A moment of silence was observed in memory of deceased members of the five-year group and also in honor of club members and other Champion employes who are now in the armed forces.

T. L. Jamison, assistant superintendent of the electrolytic bleach plant, was master of ceremonies.

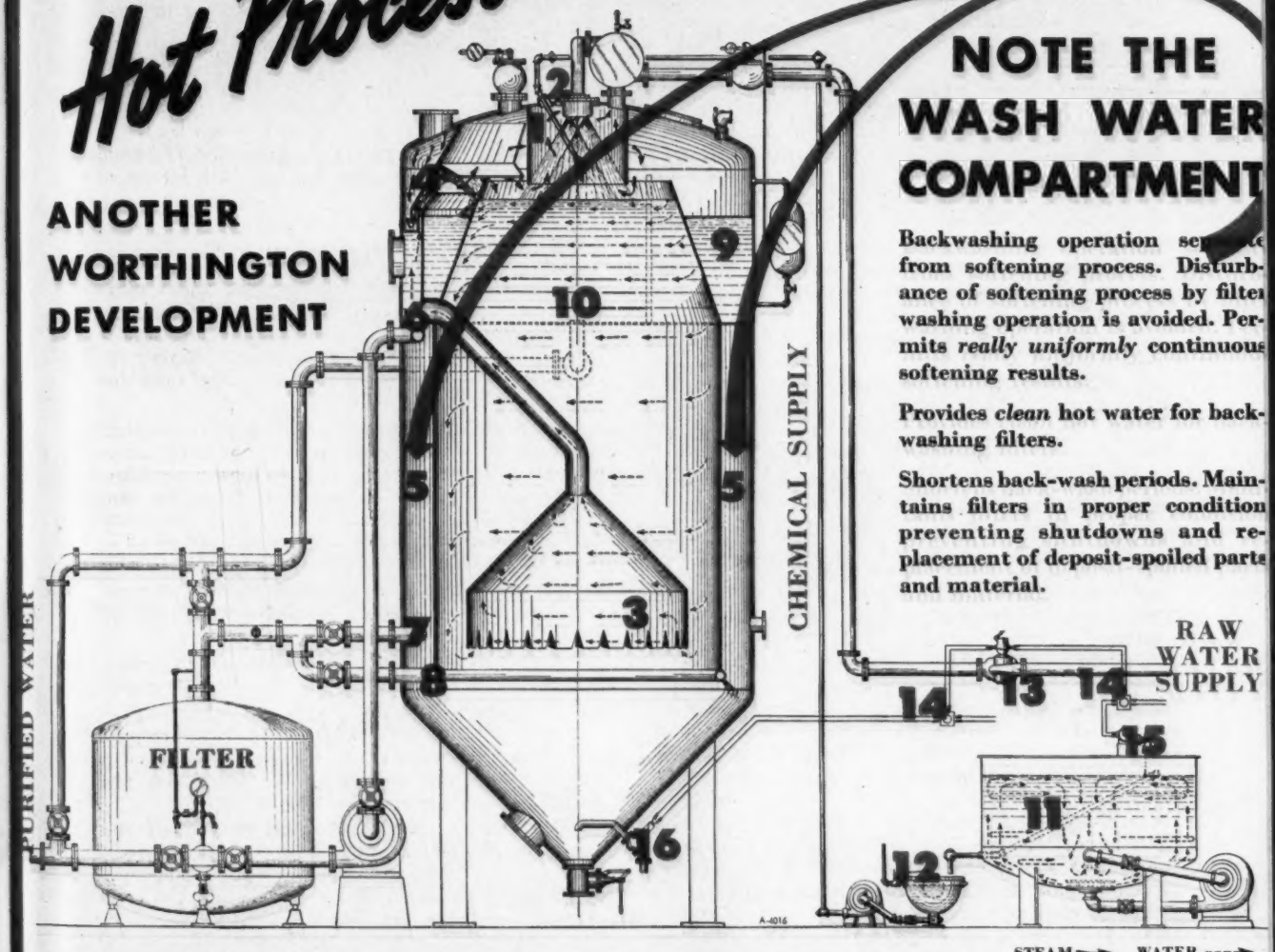
Philadelphia Paper Men Meet

[FROM OUR REGULAR CORRESPONDENT]

PHILADELPHIA, Pa., September 28, 1942—A special and important meeting of the Paper Trade Association of Philadelphia was called by president George Weaver, on Thursday last, in the Drexel Building. Bob Ziegler of the National Paper Trade Association, was guest speaker, and discussed some very vital information for the paper trade. At this meeting, president Weaver exhorted all those in the paper industry to join in the metal scrap drive for the War Effort. It was decided to appoint a committee to aid in this drive, with Howard W. Lee, vice president and general sales manager of Quaker City Paper Company, as chairman. Mr. Lee swung into action at once by placing containers in the various large establishments in this area where scrap metal may be deposited, and any one wishing to be supplied with these containers may obtain same by contacting Mr. Lee.

The only uniformly continuous Hot Process Water Softener!

ANOTHER WORTHINGTON DEVELOPMENT



STEAM ——► WATER ----►

NOTE THE WASH WATER COMPARTMENT

Backwashing operation separate from softening process. Disturbance of softening process by filter washing operation is avoided. Permits *really uniformly* continuous softening results.

Provides *clean* hot water for backwashing filters.

Shortens back-wash periods. Maintains filters in proper condition preventing shutdowns and replacement of deposit-spoiled parts and material.

And check these numerous other features

1. Primary Heater. Non-scaling. Efficiently heats the raw water and provides rotary mixing of water and chemicals.
2. Chemical Applicator. Removable. Sprays chemical through steam. Facilitates mixing and reaction.
3. Up-take Cone. Baffled serrations assure even draught. Increases softener capacity 50% over common practice.
4. Deaerating Heater. Simple. Effective. Self adjusting. No moving parts.
5. Wash Water Compartment. (See above).
6. Supply to Filter Wash Pump Suction.
7. Discharge of Dirt Laden Wash Water. Reclaimed by settling clear within 1½ hours.
8. Cleansing Ring. Provides uniform distribution of jets for washing softener precipitate and wash water sediment to central area of conical bottom.
9. Storage for Treated and Deaerated Water.
10. Treated and Deaerated Water Outlet to filters or direct to boiler feed pumps.
11. Chemical Agitator. Maintains chemical mixture of uniform strength. No submerged bearings or paddles. No objectionable surface wave action to interfere with decantation.
12. Chemical Dilution and Pump Suction Tank.
13. Proportioning Meter. Accurate. Low loss. Equipped with totalizing register.
14. Relays. Adjustable time interval.
15. Decanting Mechanism. Sturdy. Reliable. Accurate.
16. Sludge Remover. Removes sludge in proportion to its rate of formation.

For full details Bulletin W-212-B2 is available at district offices (in all principal cities) or at headquarters.

WORTHINGTON

WORTHINGTON PUMP & MACHINERY CORPORATION · GENERAL OFFICES: HARRISON, N. J.

CONSTRUCTION NEWS

Under limitations order L-41 all projects involving expenditures of more than $5,000 must be specifically approved by the War Productions Board. The status of projects reported herewith under the provisions of the order is not known.—EDITOR.

Savannah, Ga.—The Union Bag and Paper Corporation, Savannah, plans construction of a new wharf at Ossabow Island in a tributary of the Bradley River, approximately four miles above Ossabow Sound, to be used in connection with handling of raw material for pulp and paper mill at Savannah. Application has been made to War Department, Washington, D. C., for permission to proceed with work.

St. Paul, Minn.—The Minnesota Rag and Paper Company, 243 Starkey street, has completed plans for new addition to boiler house at plant, with installation of equipment for increased capacity. No estimate of cost announced. Contract for building erection has been awarded to Gustav Anderson, 1199 Edmund avenue, St. Paul, and work will be placed under way at early date. Company also will extend coal bins and make other improvements in present boiler plant.

Longview, Wash. — The Pacific Paperboard Company, Columbia way, manufacturer of paper board products, container board, pulp board, etc., will soon complete a new two-story addition to mill, about 40 x 80 feet, previously referred to in these columns, and will place at once. It will be equipped for expansion in production division and is reported to cost close to $30,000, including equipment.

Tama, Iowa—Fire recently at mill of Central Fibre Products Company, Tama, manufacturer of filler board, chip board and kindred paper goods, destroyed a large quantity of paper stock, including slight damage to mill. Loss is estimated at $12,000. Mill damage will be replaced at once.

Flushing, L. I.—The Eastman Kodak Company, Kodak Park, Rochester, N. Y., manufacturer of photographic and other special processed papers, films, etc., has arranged for lease of a two-story building at 133-35 Roosevelt avenue, Flushing, Queens Borough, and will occupy for local factory branch, storage and distributing plant. Building will be improved and possession taken at early date. An option has been taken to purchase the property at a later date.

Laurel, Miss.—The Masonite Corporation, manufacturer of insulating board and other wood pulp products, is holding to a capacity schedule at mill at Laurel, with full working force in all departments. A large part of output at present time is for Government account, in connection with new army posts and other military camps in different parts of the country. It is expected to hold to present production basis for an indefinite period. Company has recently completed a large expansion program at mill, providing for considerable increase in capacity.

Kingsport, Tenn. — The Tennessee-Eastman Corporation, Kingsport, manufacturer of staple fiber, rayon products, etc., has work under way on large mill for production for Government, consisting of several one and multi-story processing and production buildings, with laboratory, storage and distributing structures, administration building and miscellaneous units, with power station, Completion is scheduled early in 1943. Financing is being provided by Defense Plant Corporation, Washington, D. C., Federal agency, and program is being carried out under the supervision of the District Office of the U. S. Corps of Engineers, Kingsport.

New York, N. Y.—Louis DeJonge & Co., 161 Sixth avenue, manufacturers of special paper products, has developed a new metallic paper at its mill on Tompkins avenue, Richmond, Staten Island, made of non-critical materials. It is available in gold and silver. The metallic powder employed as a coating base is developed from the unusable residue of zinc smelters; the paper is partially moisture-proof and is said to be slightly lower in cost as compared with metallic stocks produced from other materials. A large output of the new material will be manufactured at the mill.

Appleton, Wis.—The Appleton Machine Company, 718 South Oneida street, manufacturer of paper mill equipment, has awarded general contract to the Hoffman Construction Company, 1519 North Oneida street, for an addition to boiler house at plant. Construction will be carried out at once. No estimate of cost announced.

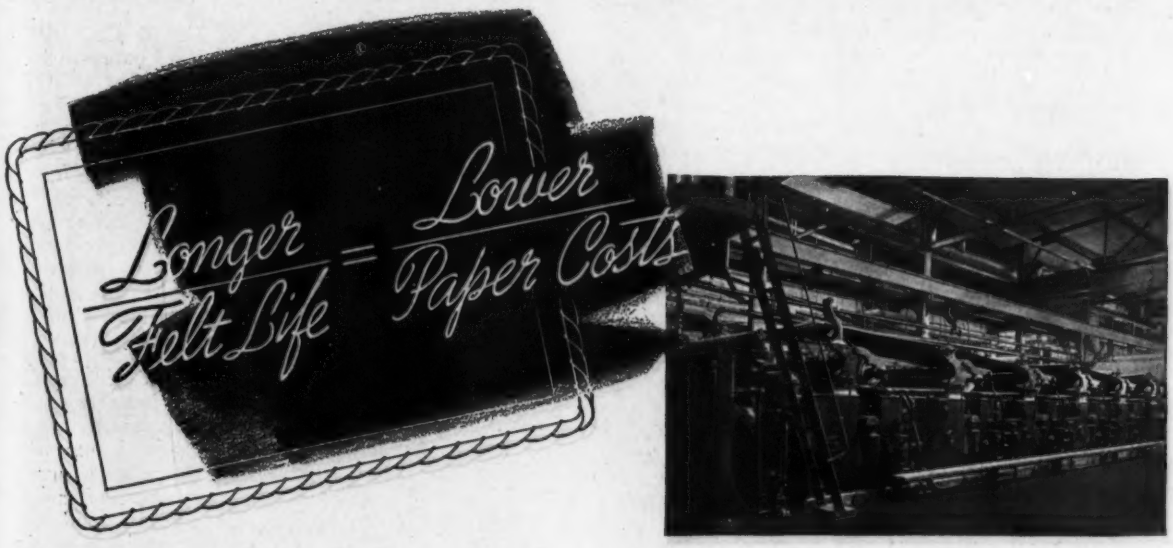
WPB Lauds Paper Key Drive

Herbert L. Gutterson, Chief, General Salvage Section, Conservation Division of the War Production Board, has congratulated the Paper Industry on its "Key to Victory" Campaign to raise 100,000,000 keys throughout the nation, metal from which goes to the United States Navy, in a letter to The National Paper Trade Association which is assisting the campaign sponsed by the Paper Industry. Proceeds from the sale of the salvaged metal are being donated to the USO by the Paper Industry and according to Prescott S. Bush, National Campaign Chairman of the USO, this will be the largest single contribution yet received by his organization if the drive reaches its goal.

R. C. Kettles, Jr., president of the National Paper Trade Association, states that: The "Key to Victory" campaign is gaining momentum hourly and from all indications it is going to develop into a very successful collection drive which will mean a great deal in terms of publicity and benefit to the Paper Industry. The date of the campaign is now extended to October 15, which means that if you have not as yet secured your Key Kans, it isn't too late to contact the Tanglefoot Company, Grand Rapids, Mich., immediately and have some Kans sent to you so that you may enter into the program.

DOWICIDE

INDUSTRIAL GERMICIDES AND FUNGICIDES



Important savings in paper manufacture are being accomplished through the use of DOWICIDE*. These chlorinated phenol products, which prevent bacterial growth, are proving a major factor in prolonging the life of paper mill felts—an important cost item in paper operations.

DOWICIDE G is recommended as a germicidal solution to wash felts during shut-downs. In mills where felts are subject to heavy loads and where there are no shut-downs, DOWICIDE G is added continuously. *Felt life extension of 50% to 200%* has resulted from treatments using a concentration of 50 parts per million.

For complete information on the treatment of felts, write for Technical Bulletin No. 44. Address Dowicide Division.

*Trade Mark Reg. U. S. Pat. Off.

DOW

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN
New York, Chicago, St. Louis, San Francisco, Los Angeles, Seattle, Houston

Use Dowicide

(1) To control slime conditions.

(2) To prevent stain and decay on pulp logs.

(3) To preserve lap and pulp stock.

(4) To prolong felt life.

(5) For mold-resistant paper products.

(6) To preserve proteins, starches, and other sizing materials.

(7) To reduce maintenance costs.

FINANCIAL NEWS

New York Stock Exchange

High, Low and Last for Week Ending September 26, 1942

STOCKS	High	Low	Last
A. P. W.	....	....	....
Armstrong Cork Co.	28½	26¾	28½
Celotex Corp.	6⅜	6⅛	6½
Celotex Corp., pf.	68	67¾	68
Certain-Teed Products Corp.	2⅛	1⅞	2⅛
Certain-Teed Products Corp., pf.	26⅜	24½	26⅜
Champion Paper & Fibre Co.	16½	16	16⅜
Champion Paper & Fibre Co., pf.	95	95	95
Congoleum Nairn Co.	16¼	16¼	16½
Container Corp. of America	13⅞	12½	13⅜
Continental-Diamond Fibre Co.	6⅛	5⅞	6⅛
Crown-Zellerbach Co.	12⅜	11⅞	12⅛
Crown-Zellerbach Co., pf.	85½	84¼	85½
Dixie-Vortex Co.	8	8	8
Dixie-Vortex Co.—A.	36½	36½	36½
Flintkote Co.	11	10½	11
Robert Gair	1⅝	1½	1⅝
Robert Gair, pf.	8¼	8¼	8¼
International Paper Co.	9⅛	7⅞	9
International Paper Co., pf.	48	45	47½
Johns-Manville Corp.	59⅜	58½	59⅛
Johns-Manville Corp., pf.	124½	124½	124½
Kimberly Clark Corp.	26½	26½	26½
MacAndrews & Forbes	....	....	....
MacAndrews & Forbes, pf.	....	....	....
Masonite Corp.	27½	26¼	26¾
Mead Corp.	6⅜	6¼	6¼
Mead Corp., pf.	65¼	65	65
Paraffine Companies, Inc.	....	....	....
Paraffine Companies, Inc., pf.	....	....	....
Rayonier, Inc.	8¾	8¼	8¾
Rayonier, Inc., pf.	25⅞	25⅜	25⅞
Ruberoid Co.	18¼	17⅞	18¼
Scott Paper Co.	35	34	35
Scott Paper Co., pf.	113⅜	113⅛	113⅜
Sutherland Paper Co.	21½	21¼	21½
Union Bag & Paper Corp.	7⅞	7½	7¾
United Paperboard Co.	3⅜	3⅛	3⅜
U. S. Gypsum Co.	53¼	51¼	53¼
U. S. Gypsum Co., pf.	173	173	173
West Virginia Pulp & Paper Co.	12	10½	12
BONDS			
Abitibi Pulp & Paper Co. 5s '53	69¾	69¼	69¼
Celotex Corp. 4½s '47	96¼	95	95
Certain-Teed Products Corp. 5½s '48	91½	90½	91½
Champion Paper & Fibre Co. 4½s '50	103½	103½	103½
Champion Paper & Fibre Co. 4¾s '50	....	....	....
International Paper Co. 6s '55	105¼	105	105¼
International Paper Co. 5s '47	103⅜	103¼	103¼
Mead Corp. 4½s '55	....	....	....
West Virginia Pulp & Paper Co. 3s '54	103¼	103¼	103¼

New York Curb Exchange

High, Low and Last for Week Ending September 26, 1942

STOCKS	High	Low	Last
American Box Board Co.	....	....	....
Brown Co., pf.	....	....	....
Great Northern Paper Co.	27¼	27¼	27¼
Hummel-Ross Fibre Corp.	3½	3½	3½
National Container Corp.	8¼	8¼	8¼
St. Regis Paper Co.	1⅜	1¼	1¼
St. Regis Paper Co., pf.	....	....	....
Taggart Corp.	2¼	2½	2½
BONDS			
American Writing Paper Co. 6s '61	....	....	....

S. D. Warren to Call Bonds

The S. D. Warren Co., on September 25 issued notice that the company's first closed mortgage, 15 year, 4½% sinking fund bonds, due May 1, 1952, will be redeemed to holders of the bonds bearing the advertised numbers only, at $1,000 each.

Soundview Earns $1.35

The Soundview Pulp Company and wholly-owned subsidiaries for the eight months to August 31, reports a net income of $741,418, equal after preferred dividend requirements, to $1.35 each on 488,250 common shares, compared with $1,260,361 or $2.41 a common share for first eight months of 1941.

Abitibi Net Earnings Up

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., September 28, 1942—Earnings of the Abitibi Power and Paper Company, for the month of August, 1942, prior to audit, charges for depreciation, bond interest of $259,597.97 (includes interest on overdue and unpaid interest) and income and excess profits taxes, amounted to $575,344, as compared—on a similar basis—with $866,139 in August, 1941, and $507,744 in July, 1942.

Included in the above earnings for August, 1942, was $124,443.01 received as premium on United States funds. Bond interest of $259,498 for such month is exclusive of the premium which would require to have been provided to permit payment of such interest to be made in U. S. funds, as may be required.

Shipments of newsprint in August, 1942, amounted to 29,208 tons, as compared with shipments of 38,937 tons in August, 1941, and 24,726 tons of newsprint in July, 1942. Present indications are that shipments of newsprint in September will be about 33,000 tons, as compared with 44,299 tons of newsprint in September, 1941.

Masonite Profits Decline

The Masonite Corporation, for twelve weeks ended August 31, 1942, reports a net income of $151,251 after taxes and charges, equal after preferred dividends to 21 cents a share on 539,210 common shares; year ago $830,800 and $1.49 a share; fiscal year, sales $17,306,208, compared with $13,109,030; net income $1,448,434 after taxes and charges, equal after preferred dividends to $2.39 a share; year ago $2,010,886 and $3.56 a share. Income tax provision for fiscal year $4,722,000 against $1,420,244 the previous year.

Hummel-Ross Nets 51 Cents

The Hummel-Ross Fibre Coruoration for the thirty-six weeks to September 5, reports a net income, after $693,816 estimated income and excess profits taxes based on tax rates proposed by House of Representatives, was $231,272, equal, after preferred dividend requirements, to 51 cents each on 391,706 common shares. Net income for thirty-six weeks to September 6, 1941, was $418,984, or 99 cents a common share after $628,476 tax charges. Net sales totaled $3,557,605, against $3,174,327.

Container Corp. Votes Dividend

The board of directors of the Container Corporation of America has declared a dividend of 75 cents per share, payable November 20, 1942 to stockholders of record as of the close of business on November 5, 1942. The directors also announced that since the first of the year the term bank loans of the company have been reduced by $2,300,000 leaving an unpaid balance of $600,000 as of September 24, 1942.

Victory Rests on Results of Salvage Drive

The great importance of salvaging steel, copper and all essential metals, and rubber, is explained in the Official Plan of the National Salvage Program, issued by the Bureau of Industrial Conservation, War Production Board, Washington, D. C. It states that the Salvage Program is not a one-week or a one-month campaign, any more than this is a one-week war. Salvage is an all-out continuing effort and must be organized as such.

The Official Plan provides full information on how to conduct all phases of the salvage job. It points out that there is no single "best way" to collect scrap. Donald Nelson says "It is a problem that can be licked only by American initiative, American organization ability, American muscle and the American will to win."

The main objectives are: (1) To canvass in person every home, every farm, every office, every business establishment, and every institution. (2) To provide the necessary man power and transportation for an initial "clean up" and to set up methods for periodic and dependable collection for the duration of the war. The Official Plan gives all the necessary information on the subject. It tells how to form state and local salvage committees, how to arrange for salvage depots, how to conduct salvage operations, what vital materials are needed and a list of national, state, and field organizations.

The American Industries Salvage Committee, 50 Rockefeller Plaza, New York, states that the last line of the following night letter sent to several thousand American business executives stimulated action in the current Campaign on Scrap Iron and Steel.

Continued capacity operation of steel mills depends entirely on success of scrap salvage drive. Appreciate all help given to date but urgently request intensified effort on part of everyone. Respectfully suggest you order immediately and use printed matter shown in Victory-Gram broadside sent you last week. This includes free outdoor 24 sheet posters and free window stickers. Also envelope inserts at $1.00 per thousand and three display posters at $1.00 per set. Cannot fill orders after September 18 deadline. Plain truth is that victory rests on results of campaign.

The spearhead of this part of the program was a direct mail appeal for cooperation to 17,000 top executives of all classes of industry and business. Sent on September 8, the Victory-Gram broadside urged these men to use their advertising and distribution facilities to drive home to everyone the vital message to get in the scrap.

As a result of the broadside and telegram, letters are pouring in telling how various companies are participating in the all-important scrap drive. Clippings of scrap advertisements ranging from single lines to full page messages are arriving by scores.

The specially prepared Salvage printed material offered through the broadside is overwhelmingly oversubscribed. For instance:

(1) Some 4,000 twenty-four sheet outdoor posters will be on the boards all over the country beginning September 30, thanks to outdoor plant operators.

(2) Well over 1,000,000 window sticker adaptations of the 24-sheet will be distributed free.

(3) Almost one and half million of the little four-page envelope enclosures will be shipped on September 30. These were purchased at $1 per thousand by business concerns.

(4) Some 180,000 single sheet Salvage posters have been ordered.

(5) 25,000 or more car cards will go up in railway and street cars and buses, all over the nation early in October—a fine tribute to the willingness of transportation men to ride along with the Salvage Drive.

Copies of the above material (except the 24-sheet poster) will be sent to 11,000 Local Salvage Committee Chairmen to keep them informed of every operation.

The Victory Display Committee, headed by L. S. Janes and Ed Graceman of Sears, Roebuck, Chicago, have cooperated magnificently in the Salvage Drive and expect to use the "ready-made" Salvage display material in upwards of 150,000 "Scrap" window displays in retail stores everywhere during the period of October 17 to 30.

Operating through 400 Local Victory Display Committees, the V.D.C. secured 300,000 Window Displays for the War Bond and Stamp Campaign.

Still another part of the campaign is the coverage of over 5,000 daily and weekly newspapers through two timely and carefully conceived plans. The Meyer-Both Plan and Metro Newspapers Service left no stone unturned in order to provide newspapers with unusually effective and salable tie-in ads.

A small but none the less welcome contribution to the campaign is the Ever Ready Label, which was mailed along with letters and broadsides.

And so far as radio is concerned, you can't tune in any program regularly without hearing a salvage announcement or even a whole program devoted to scrap.

During the summer newspapers all over the country have been running paid ads on scrap and their cooperative efforts have been truly amazing. A few days ago the newspapers were called on again for collateral measures to support the Scrap Campaign. At a general meeting, they were presented with a mimeograph manual of suggestions entitled "Newspapers United Scrap Metal Drive." Events are developing with such a rapid-fire speed that already 1800 newspapers have pledged themselves to Mr. Donald Nelson to put the full Power of the Press behind the Salvage Drive.

Magazines are devoting special editorials, feature pages—yes, and even front covers in full color to the Salvage Campaign as their part of the drive.

1,000,000 Educational Classroom Charts will be distributed to the schools of this country to teach children the importance of scrap in making steel.

Motion pictures have not been overlooked in this campaign. Announcements of special salvage "shorts" already have been released through the Theatres Division of the War Activities Committee to 17,000 motion picture exhibitors.

All in all, the Salvage Campaign is one of the most complex and far-reaching educational, advertising and publicity efforts attempted in our time.

It is easily one of the greatest efforts ever made to influence our people– and it must be great, for it must achieve its goal—remember,—

"The Plain Truth is that Victory Rests on the Results of this Campaign."

ASPHALT SPECIALTIES FOR PAPER... DELIVERED PROMPTLY

Your orders for asphalt specialties for paper production can be delivered *immediately* from Wishnick-Tumpeer's strategically located plants. These plants are equipped to produce at high speed a considerable volume of products in addition to those required from them for war purposes.

Pioneer Asphalts, produced by Wishnick-Tumpeer, Inc., is a name of long standing in the paper and other industries. A diversified variety of Pioneer Specialties is available, and others can be manufactured on specification to meet special requirements. Among the uses for which Pioneer products can be produced for exacting needs are waterproofing, laminating, saturating and coating paper and paper products. In addition to high quality service, Wishnick-Tumpeer offers the cooperation of its modern research and product development laboratory in helping customers select the materials best suited to their specific requirements. Write, phone or wire today for complete information on PIONEER ASPHALT SPECIALTIES for paper production.

WISHNICK - TUMPEER, INC.

MANUFACTURERS AND EXPORTERS

New York, 295 Madison Avenue • Boston, 141 Milk Street • Chicago, Tribune Tower • Cleveland, 616 St. Clair Avenue, N. E. • Witco Affiliates: Witco Oil & Gas Company • The Pioneer Asphalt Company • Panhandle Carbon Company • Foreign Office, London, England

Dr. Forman Goes with Institute

Westbrook Steele, executive director of the Institute of Paper Chemistry, has just anounced the appointment to the Institute's staff of Dr. Loren V. Forman as a research associate, who will be instructor in pulp and paper technology and in charge of pulp and paper testing.

Dr. Forman is a native of Iowa and received his undergraduate training at Iowa State College, receiving a B. S. in chemical engineering in 1934. Undergraduate honors included membership in Tau Beta Pi, Phi Lambda Upsilon, Omega Chi Epsilon, and Knights of Saint Patrick, honorary chemical and engineering societies. He is also a member of Theta Delta Chi.

He is an alumnus of the Institute, receiving his M. S. degree in 1936, and his Ph. D. degree in 1940. His Master's thesis was on the bonding strength of

Dr. Loren V. Forman

adhesives; his Doctor's work dealt with the effect of ultraviolet light on lignin. During this period he spent two years with the Munising Paper Company.

While a third year student at the Institute, Dr. Forman was awarded a fellowship of the American-Scandinavian Foundation of New York City. This fellowship was established by Nils R. Johaneson, president of the Cellulose Sales Company of New York and gives the recipient an opportunity to study at any Swedish school and to observe pulp and paper manufacturing at first hand in the Scandinavian countries. Dr. Forman arrived in Stockholm early in September, 1939, and spent some time in visiting laboratories and mills. He had just started a research problem under Professor Erik Haegglund of the Institute of Wood Chemistry and Pulp Technology at the Royal Institute of Technology at Stockholm, when conditions resulting from the war made it necessary for him to return to the United States in December, 1939.

Since 1940, Dr. Forman has been associated with the Mead Corporation, dividing his time between the Chillicothe, Ohio, and the Kingsport, Tenn., mills of the corporation.

A Letter from Scotland

R. S. Rowlett, sales manager of the McLaurin-Jones Company, Brookfield, Mass., in a letter just received says:

"Attached is a copy of a letter recently received from our related company, Smith & McLaurin, Ltd., of Scotland. This is a most illuminating commentary on the British ability to see it through. I think you may want to copy this letter in your columns."

The letter referred to from Arch. MacLaurin of Smith & McLaurin, Ltd., Cartside Mills, Milliken Park, Scotland, follows:

"Many thanks for the very handsome sample book of gummed papers you sent me. In a way I envy you your still ample supplies of good papers for sampling. We haven't made a new sample book for nearly three years.

"We are making paper here from straw, old waste paper, wood workers wash, shavings and sawdust, with a liberal proportion of old boots, discarded braces, and similar indigestible items thrown in for luck (and incidentally to add weight for which papermaker pays). Straw is the aristocrat of the lot, and it's wonderful what good paper can be made from straw—if you have the proper plant, which we haven't yet in this country. I enclose sample of paper made from wood free, but containing 75% of shavings, chips and sawdust.

"How would some of your papermakers who are grumbling of deterioration of your wood stocks like to work this, and would they make as good a job?

"It's a punishable offense for a man to throw on the ground a used cigarette carton, and the improvement in the condition of the streets and countryside is amazing.

"It has been a revelation to me what can be done with hitherto despised and wasted materials, and the Paper Trade have risen to the emergency nobly. We are allowed materials only if for essential war purposes, and our help is reaching the stage of old men, old women, and young girls.

"All others are in the army or munition work.

"Give my best regards to those old friends whom I met when last in the States, and I trust the day is coming soon when I can enjoy an air trip there again. With best regards, and many thanks for the sample book, I am."

This view of a woodyard at the Covington mills of the West Virginia Pulp and Paper Company, is enough to stir the envy of those who may be worrying about their fuel supply for the coming winter!

Virginia has 17 paper mills and 10 pulp mills. Narrowest trim machine is 80 inches — widest trim, 228 inches. *Draper* can clothe any width.

Draper Felts Favor Efficiency

DRAPER BROTHERS COMPANY

Woolen Manufacturers Since 1856 CANTON, MASS.

OUR REPRESENTATIVES *to serve you*

L. H. BREYFOGLE, Kalamazoo, Mich.
C. K. BEECHER, Delaware, Ohio
W. L. CAMPBELL, Savannah, Ga.
O. J. LELOFF, Vancouver, Wash.
RALPH E. BRIGGS, Canton, Mass.

Power Show Opens November 30

The Exposition of Power and Mechanical Engineering, which was scheduled to be held in Grand Central Polace, November 30 to December 5, will be transferred to Madison Square Garden. It will be staged during the period November 30 to December 4—five days instead of six.

The change is due to the fact that the U. S. Army has taken over the four exposition floors of the Palace to be used as an induction center for the duration. More than 150 exhibitors have taken space in the Power Show, and these will find ample room in Madison Square Garden. Space and arrangement of exhibits will be on a basis similar to the original plans.

The exhibitors' list undoubtedly will be augmented considerably before the opening date.

The Power Exposition is held biennially and in the past has attracted engineers and technicians not only from all parts of the United States but from many foreign countries as well.

Charles F. Roth is manager of the exposition. Particulars regarding space may be obtained at headquarters, 480 Lexington Avenue, New York. Telephone number is WI 2-8234.

Scott Paper Co. Sales Expand

Consolidated net sales of Scott Paper Company for the first eight months of 1942 were 31 per cent ahead of the comparable period a year ago.

Paper Production Lower

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., September 30, 1942—Industrial production of paper and products for July stood at 127 compared with 147 for August a year earlier, using the 1935-1939 average as 100, with allowances made for seasonal variation, according to figures made public by the Federal Reserve Board.

Newsprint production for July was 103 as compared with 113 for August, 1941. Production of paperboard for August was 121, as compared with 115 for July, and 161 for August a year previous. Consumption of newsprint was 108 for August, 103 for July, and 109 for the previous August.

At the same time comparative production figures were released for the same production without the seasonal adjustment, using the same index of 100 as the 1935-1939 average. Without the adjustment the paper and paper products production was 122 for July, and 146 for August 1941. Newsprint production was 101 for July, compared with 110 for the previous August. Paperboard production indexes were 123 for August, 109 for July, and 163 for the previous August. Newsprint consumption was 95 for August, 90 for July, compared with 96 for August, 1941.

Hinde & Dauch Develop Insulation

CLEVELAND, Ohio, September 28, 1942—A new type of jacket insulator for hot water tanks has been developed by Hinde & Dauch Paper Company, it was announced today. The jacket is made of corrugated paper, a non-critical material.

HIDDEN QUALITIES
of Your Paper or Board Machine
Hidden Qualities of your paper or board machine may be secured by treating your stock with a Sutherland Single Rotating Disc Refiner.
Sutherland Refiner Corporation, Trenton, New Jersey
SUTHERLAND REFINERS

Demand Slightly Better

[FROM OUR REGULAR CORRESPONDENT]

INDIANAPOLIS, Ind., September 28, 1942 — Though there was some increase in many lines of paper in this territory last week, manufacturers and jobbers claim the increase was not as marked as had been expected at this time of the year, when there generally is a rise of some proportions. The first hint of winter last week did not do much to increase sales, as it generally does.

The trade here has begun worrying about probable transportation troubles when cold weather finally arrives. There is considerable worry also concerning the higher taxes that will be in effect not only nationally, but state, county, township and city. Every effort is being made locally to hold municipal taxes down, but there is nothing that can be done about national taxes.

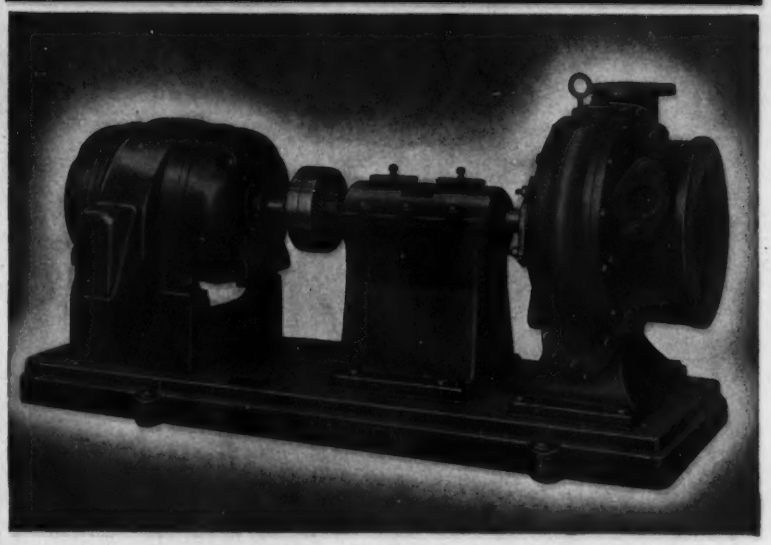
Another thing that is causing anxiety is the growing scarcity of help. Higher wages in defense plants, with which this area is crowded, has drawn what help has been left after the remainder got through joining the armed forces or were caught in the draft. Also the price of labor has risen. Costs both in paper manufacturing plants and in wholesale houses have risen during the last year to an undreamed-of scale.

However, the industry hereabouts seems to have shaken out the "bugs" and is going along on an even keel. Fine paper demand last week showed a slight increase.

Building papers and roofing continued to lag last week. The building volume will do well to equal half of last year in spite of small cost defense houses that have been built.

Kraft continued fair last week with a widening demand base. Tissues also were in good demand. The summer specialty season virtually is over and dealers have settled down to the regular fall and winter demand with adequate stocks for the most part. Inventories of summer specialties will be light.

NOT *SIX* MINUTES ... BUT *THREE*



is the time taken by a Warren Type SOD Pump in which to fill the Beater in one of the efficient rag mills that have made Western Massachusetts so well and favorably known in the fine paper field. This particular pump was bought to do the job in six minutes but the reserve capacity cut the time exactly in half.

Sooner or later you will be confronted with conditions or circumstances where added capacity without additional cost in equipment or maintenance would be a real asset. Prepare for such an eventuality by always specifying and insisting upon

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASSACHUSETTS

Urges Conservation

A new forest conservation poster has just been released by the Industrial Department of the Seaboard Air Line Railway. This poster, according to Charles A. Gillett, the Railroad's Industrial Forester, is aimed at assisting the war effort by urging wise timber cutting in meeting the many war needs of today. Wood has been classed as an essential post-war material and every effort must be made to plan for tomorrow's needs while supplying the necessary forest products to help win the war. In addition to the regular uses of wood in construction, crating, poles and piles, cross ties, paper, etc., forests are now furnishing wood cellulose for the manufacture of rayon fabrics, plywood planes, alcohol, fiber board, malleable woods and wood plastics. The one hundred and eleven million acres of forest land in the six southeastern states served by the Seaboard Air Line Railway must and will do their part to meet today's needs. Cutting forests wisely will permit them to meet these needs and at the same time give their owners the greatest possible return. Timber will also be made available for the years to come.

The poster is attractive and printed in three colors. The background of the poster is a beautiful stand of trees with a red, white and blue streamer across it reading, "Plan For Tomorrow In Meeting Needs Of Today—Cut Timber Wisely." Posters are available to those desiring them and may be secured by writing the Industrial Department of the Seaboard Air Line Railway at Norfolk, Va.

KEEP YOUR BELTS "FIGHTING" LONGER

Cincinnati Power Transmission and Conveyor Belts are fighting equipment in the battle of production. They are tough . . . they can take it as fast as it is dished out and that means 24 hour stretches . . . but extra care is going to keep them in there "pitching" longer. Conserve this vital equipment . . . help Cincinnati Belts do the biggest job they have ever been called upon to do . . . to help produce many of the essential needs for victory.

Making your Cincinnati Belts last longer is easy. Folders carrying important information have been mailed to thousands of manufacturers throughout the U. S. If you did not receive a copy of these important suggestions, write to us and it will be mailed immediately. Do it now for it may mean making your Cincinnati Belts last months or even years longer . . . and that is bad for the Axis.

THE CINCINNATI RUBBER MFG. COMPANY
CINCINNATI, OHIO

CINCINNATI
TRANSMISSION BELTS
CONVEYOR BELTS
RUBBER COVERED ROLLS
— HOSE —

Carter, Rice Resume Wagon Delivery

Carter, Rice & Co., Corporation, is the first paper firm, at least in Boston, to resume the use of a horse and wagon for deliveries. The company started with

BACK TO HORSE AND WAGON

motor driven trucks in 1911 and is now back to the horse in 1942. It is expected that more horses will be used by the company later. The picture left to right shows Bill O'Brien, helper and Wayne Buswell, driver.

Issue Complaint Against Mono Service

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., September 30, 1942—Federal Trade Commission has issued a complaint charging the Mono Service Company of Newark, N. J., engaged in the manufacture of paper cups for the packing of ice cream, with supplying others with the means of conducting lotteries in connection with sale of its products and ice cream.

The complaint alleges that the Company's cups are packed with an unattached lid for each cup and that some of these lids have a star printed on the reverse side. The cups are sold to manufacturers or packagers of ice cream, and retail dealers who sell ice cream packed in the Company's cups award an extra cup of ice cream to purchasers of cups having a star appearing under the lid.

Sale of the ice cream cups to the purchasing public in this manner, the complaint charges, involves a game of chance. Many dealers are attracted by the method and sales plan and are induced to buy the merchandise in preference to that of competitors who do not use the same or equivalent sales plans or methods, according to the complaint.

Atlantic Bag & Paper Co. Moves

JACKSONVILLE, Fla., September 28, 1942—The warehouse of the Atlantic Bag and Paper Company has been taken over by the Government for the ship building company to make "Liberty Ships." The concern is now located at its new warehouse at 920-922-924 West Bay street. This comprises four different buildings and when finished with the remodeling, repairing, etc. the company will have about 25,000 square feet and railroad siding in the back.

Logging Made Priority in British Columbia

Logging in British Columbia has now been made a priority occupation. Loggers who stay on the job in future will be given exemption from military service, while for other purposes they must stay on the job. R. J. Filberg, Bruce Farris and Reg. Stewart, prominent B. C. logging and lumber operators, visited Ottawa recently to ask for the formation of a loggers' battalion to aid the B. C. situation, and told the government there is an immediate shortage of 2500 loggers in B. C. The only way to get logs cut and marketed is to make it a semi-military job, they contended and suggested that several thousand loggers be recruited for a loggers' battalion to continue logging operations.

The Government has decided to obtain the same results another way. No formal battalion will be formed, but loggers who work at their calling in the woods will be able to obtain postponements of military service.

To make the new plan work successfully, however, co-operation of loggers in staying on their normal jobs is essential.

It is estimated that fallers in the past have been in the habit of only working 60% of their time. The remainder of available working days in the year they spend quitting one camp for town life and then signing on at another camp. Under the new set-up the logger can't quit without adequate notice and then if medically fit, and most loggers are, he can't get another job but is compelled to join the army.

O. P. Gephart Resigns

Orvan P. Gephart, superintendent of the Miamisburg Paper Company division of The American Envelope Company located at Miamisburg, Ohio, announces his resignation. Mr. Gephart is not yet ready to state definitely what his future plans are, but it is understood that he has several opportunities under consideration.

His place has been taken by Herbert A. Brawn, who for the past eight years has been superintendent and assistant manager of the Howard Smith Paper Mills, Ltd., of Beauharnois, Quebec, Canada, and prior to that superintendent of the West Springfield Mill of the Strathmore Paper Company.

4

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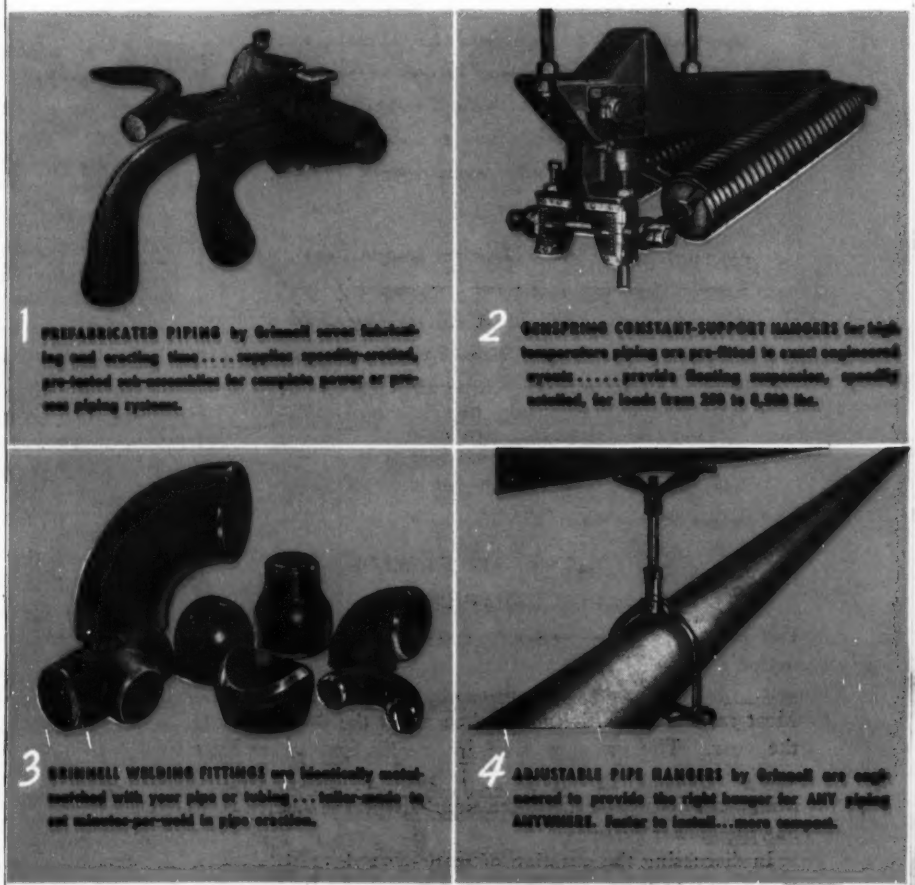

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PAPER TRADE JOURNAL

This Reg. U. S. Pat. Off.

Henry J. Berger

EDITOR

Vol. 115 October 1, 1942 No. 14

COMING EVENTS IN PAPER INDUSTRY

New England Section. Technical Association of the Pulp and Paper Industry—Third Friday of each month at the Roger Smith Hotel, Holyoke, Mass.

Delaware Valley Section. Technical Association of the Pulp and Paper Industry—First Friday of each month at the Engineers Club, Philadelphia, Pa.

Lake States Section. Technical Association of the Pulp and Paper Industry—Second Tuesday of each month at the Conway Hotel, Appleton, Wis.

Kalamazoo Valley Section. Technical Association of the Pulp and Paper Industry—First Thursday of each month at the Park, America Hotel, Kalamazoo, Mich.

MANPOWER

The successful prosecution of the war dominates current opinion. The subject is so extensive in scope that many complicated problems must be met. Tax proposals, inflation and manpower are all vitally important questions at this time; rationing, rubber production and the output of war materials are of equal necessity. In commenting on the week in Washington, the *Review* issued by the Chamber of Commerce of the United States, points out that, "Different routes have been pursued by the Senate and House toward enacting legislation demanded by the President to arrest the rising cost of living. . . . While Congress struggled with that problem, the effect of the war was felt anew on many fronts. WPB ordered coupon rationing of fuel oil, effective October 1, in 30 states. Plans presumably are being made speedily for nationwide rationing of gasoline and for a national speed limit of 35 miles an hour, two points recommended by the well-received report of the Baruch rubber committee . . . President Roosevelt says in another lend-lease report that civilian production must be cut to the bone; that only half of the nation's potential resources have been mobilized for war. Farm implement production will be curtailed. Meat rationing may be undertaken about the first of the year. The growing pinch of civilian economy continues. Unexpected demands for men for the armed services raise new questions about the draft and manpower generally."

In discussing the question of manpower the article says in part: "From all directions the demands for manpower increases. The armed forces are looking ahead to the time, not so far distant, when 13,000,000 men will be needed for the several branches of the fighting services. War industries are crying for workers. Farmers are short of help. Business supplying civilian needs is being drained of workers for war plants. Merchant ships want seamen. The requirements of the Army are put forward by Draft Director Hershey, who predicts induction of from 1,000,000 to 1,500,000 married men, having dependents, before the end of 1943, unless drafting of 18 and 19 year olds is authorized soon. Already, some of those married, but having no children, are being called. Even before January 1, an army of more than 4,500,000 is in prospect. In the World War, 18 months of conflict found the United States with an army of only a little more than 4,000,000."

Commenting on the question of drafting workers, the *Review* goes on to say that, "Appearing before a House committee studying means for utilizing the country's manpower to the fullest extent, War Manpower Director McNutt proposed a National Service Act giving the government widest powers over the country's working population. 'I think the people are ready for it,' he said. 'We are moving rapidly into a situation where the government must intervene in the labor market, the House committee was told. Labor shortages now exist, McNutt said, in 35 of the country's production centers. Philadelphia was named as the most critical spot, with 100,000 workers needed immediately. 'The period of easy expansion of employment is over', the committee heard. 'It is improbable that we can avoid the controls already in force in other countries.' McNutt took with him to the committee hearing a table of figures. They showed that employment rose from 48,100,000 in June, 1940, to 57,000,000 in 1942. Ahead of us lies the task, McNutt pointed out, of combing all sources for millions of additional workers, while building up at the same time the enormous armed forces in prospect."

In reference to balance of manpower, the article states that, "One reason advanced for the necessity of manpower control legislation is the need of maintaining proper manpower balances. The requirements of the armed services must be met. On the other hand, the needs of war industry must be served. During the week the War Department listened to the plaint of West Coast airplane makers that men whose services are more or less indispensable are being taken into the Army. It advised the plants to appeal cases of essential employees whose deferment has been denied by local draft boards. At the same time, the department announced that voluntary enlistments of aircraft workers in 2A, 2B and 3B classes would not be accepted except on clearance by local boards. The War Manpower Commission points to serious labor shortages in 116 out of 160 war production areas. The automotive industry, to reach peak war production, will require 600,000 more workers. In California 150,000 persons have been called to harvest fields. By the end of this year almost five million women are expected to be working at war jobs."

The migration of workers into areas of heavy war production is of such grave concern that Manpower

Director McNutt has proposed legislation to stop voluntary migration from some necessary War industries, now hampering the war effort. The diversion of workers from the forest industries cannot but directly affect the production of pulpwood and result in less wood pulp available for the manufacture of paper for civilian or normal consumption. The concentration of manpower in the production of materials and products of more direct value in the war effort, must inevitably curtail the output of pulpwood as it increases the production of lumber required for war uses. It appears to be inevitable that President Roosevelt's declaration that, "civilian production must be cut to the bone," must have a very marked effect upon many major industries, included the production of paper.

Hudson Falls Mill Closed

HUDSON FALLS, N. Y., September 28, 1942—More than 400 employees of Union Bag and Paper Corporation, in Hudson Falls, were laid off last week with the closing of Allen and Fenimore Mills for an indefinite period. Alex Calder, president, said lack of orders was the cause. The shutdown applies only to the two paper mills and does not affect the bag factories in Hudson Falls.

In the statement to employees, Mr. Calder said unexpected orders based on changing war needs might justify their reopening and that a second possibility was conversion of the mills to production of critical war materials, negotiations for which are now in progress.

Production Ratio Report*

(Production as per cent of six-day capacity)

COMPARATIVE WEEKLY SUMMARIES

Current Weeks—1942		Corresponding Weeks—1941	
August 15	77.5	August 16	99.0
August 22	80.5	August 23	102.8
August 29	82.8	August 30	102.4
September 5	83.2	September 6	84.8
Sept. 12. (Holiday Week)	71.2	September 13	104.2
Sept. 19....(Preliminary)	*83.9*	September 20	103.8

COMPARATIVE MONTHLY SUMMARIES

Year	Jan.	Feb.	Mar.	Apr.	May	June	July
1941	85.6	89.7	92.2	96.0	98.7	99.3	94.2
1942	104.5	103.9	102.9	100.4	95.4	87.3	75.8

Year	Aug.	Sept.	Oct.	Nov.	Dec.	Year Avg.
1941	101.0	99.7	105.2	106.2	100.4	97.4
1942	*80.8*	....	....	....	....	....

COMPARATIVE YEARLY SUMMARIES

	1935	1936	1937	1938	1939	1940	1941	1942
Year to Date..	68.5	78.1	86.3	69.1	79.1	86.2	94.7	92.5
Year Average.	69.9	80.4	79.8	71.5	83.4	85.5	97.4	...

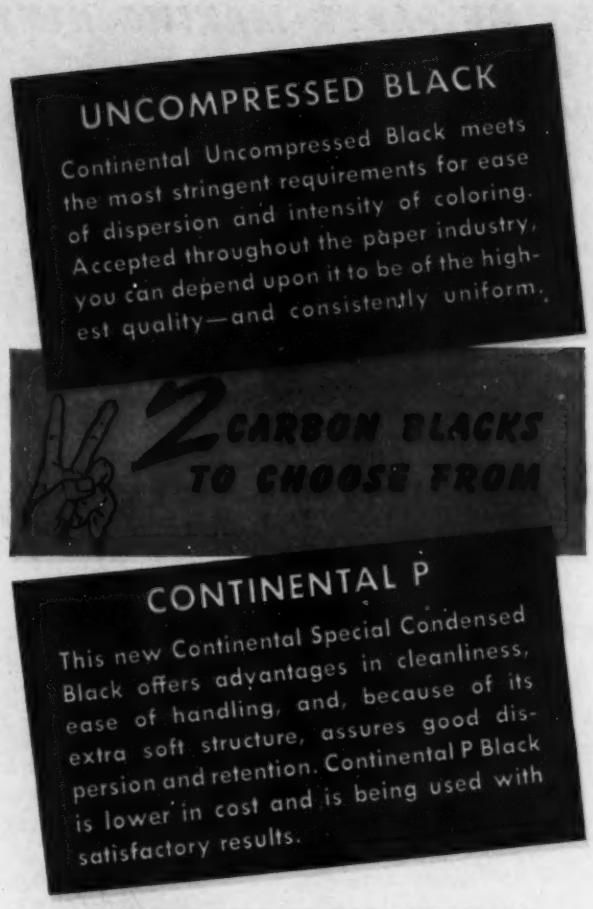
* Based on tonnage reported to American Paper and Pulp Association. Does not include mills reporting to National Paperboard Association, except in isolated cases where both paper and paperboard are produced and separate tonnage figures are not readily available. Does not include mills producing newsprint exclusively.

PAPERBOARD OPERATING RATIOS†

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year Avg.
1937	83	89	89	91	88	80	69	77	72	70	57	47	75
1938	56	63	63	60	60	59	59	60	70	73	67	61	64
1939	65	73	76	74	69	73	68	77	82	91	88	77	77
1940	78	75	74	76	82	85	77	79	78	85	82	77	78
1941	81	88	89	89	91	94	92	98	95	99	98	90	92
1942	102	101	101	95	82	72	68	75	..	..	..	..	..

Week ending Aug. 15, 1942—73 Week ending Sept. 5, 1942—78
Week ending Aug. 22, 1942—74 Week ending Sept. 12, 1942—65
Week ending Aug. 29, 1942—77 Week ending Sept. 19, 1942—*81*

† Per cents of operation based on "Inch-Hours" reported to the National Paperboard Assn.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2 CARBON BLACKS TO CHOOSE FROM
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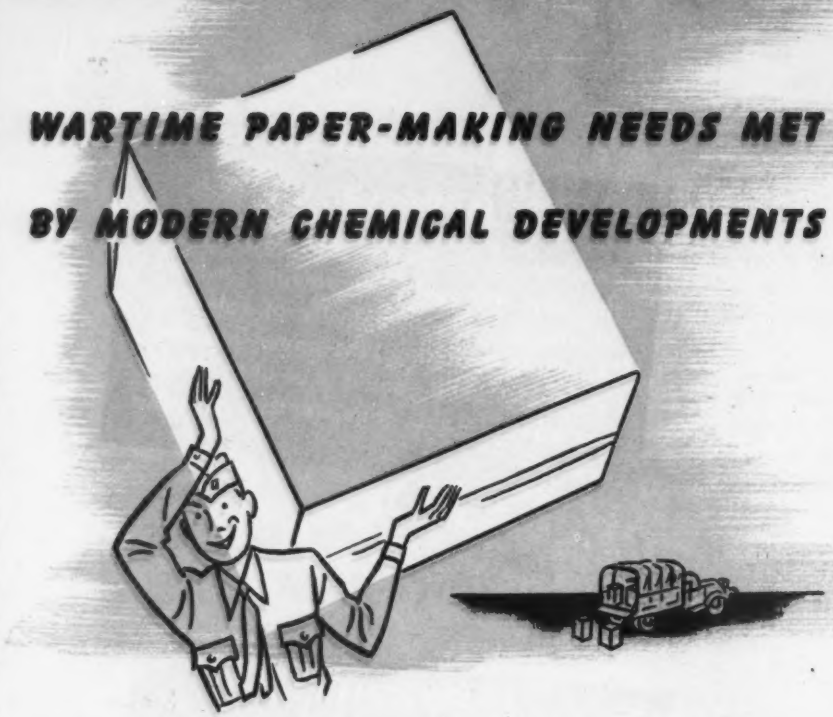
WARTIME PAPER-MAKING NEEDS MET BY MODERN CHEMICAL DEVELOPMENTS



WAR BRINGS NEW DEMANDS. Never before has so much been demanded of paper. The requirements of paper making for normal uses have not only become more difficult to meet, but paper is also expected now to step in and replace other materials such as metals, wood, glass, and fabrics.

American paper manufacturers had already made considerable progress along these lines before the influence of the war became a factor. But now the present emergency has intensified and diversified the demand tremendously. As a result, paper and paper boards are being successfully adapted to uses that would have been considered by many as being practically impossible only a few years ago. To illustrate . . .

Machinery, food products, clothing, munitions, medical supplies, and hundreds of miscellaneous light and heavy weight, durable, fragile, and perishable articles are being packed and shipped to our armed forces in every quarter of the globe in packaging materials made in many cases entirely of paper and paper board. These protective coverings have got to be good to withstand punishing handling and the effects of sun, wind, hail, rain, snow, cold, heat, and humidity.

PROGRESS BEING MADE. To give paper and paper board the properties that will make them stand up calls for a number of special paper manufacturing treatments, some of which are new to many paper makers. For years prior to the entry of the United States into the conflict, Cyanamid had been working successfully on many developments in paper chemicals and their uses in broadening the fields of paper applications. Much of this is now proving of vital importance in releasing critically needed materials for the war effort. A lot has been done, a great deal more is under way, and Cyanamid may be able to help you in your efforts to make paper do its full share in the winning of the war. A Cyanamid representative will be glad to discuss the matter with you, and arrange to give you all possible assistance.

Rigid, damage- and water-resistant cartons of specially sized paper board made to U. S. Government specifications are now used for storage and shipment of munitions supplies.

"Food will win the war and write the peace that follows." The job of the Quartermaster Corps in getting foodstuffs to the armed forces has been considerably alleviated by the many types of efficient cartoning materials developed to keep perishables in good condition.

Paper board sidings now keep out the cold and otherwise effectively insulate both temporary and permanent shelters for soldiers and workers in war industries.

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Section of the
TECHNICAL ASSOCIATION
OF THE PULP & PAPER INDUSTRY
Edited by R. G. Macdonald, Secretary

An Engineering Approach to Solution of Packaging Problems Involving Moisture Vapor Resistance*

By John F. Halladay[1]

Abstract

Because of changes resulting from war, paper technologists and military personnel are confronted with development of alternative moisture-vapor resistant (MVR) materials for use in carrying goods for civilians and the armed forces. These demands are imperative.

This paper has been written in an effort to assist those who are confronted with this problem purely as a result of war, and whose past endeavors have not demanded an entry into this field.

Moisture-vapor testing methods are briefly discussed. Their relation in perspective to the whole problem is appraised. A method for interpreting laboratory data from MVR membrane tests, based on mathematical handling alone, is developed. A method for evaluating closure methods is described. A routine for determining the effect of vapor stresses produced by the contained product is outlined. A way of calculating changes in the moisture content of materials enclosed in MVR packages is presented.

Much has been written into the literature of the paper industry concerning specific phases of problems involving resistance to atmospheric water vapor. Because of the great amount of published work on this subject, the technologist who approaches this problem for the first time can quickly become confused by the sheer volume of published information available and hence may soon lose himself so completely in the "trees" that confusion as to the size, shape and location of the "forest" overtakes him.

This paper does not attempt to cover all phases of the problem nor has it been attempted to cover the subject in a rigorously scientific manner. Rather, it should be considered as a guide through which those having packaging problems can gain a broad but not minutely exact view of the testing-methods, calculations, etc., which can be used quickly to attain objectives which must be reached with a minimum of lost motion and time.

* Presented at the Fall Meeting of the Technical Association of the Pulp and Paper Industry, Hotel Statler, Boston, Mass., Sept. 29-Oct. 1, 1942.

[1] Member TAPPI, Technical Director, American Coating Mills, Inc., Elkhart, Ind.

Water Resistance vs. Moisture-Vapor Resistance

Axioms

To those who have encountered the problem previously, this paragraph may appear as needless reiteration of commonly known facts; yet, for those less familiar with the subject, it seems desirable to mention some axioms which apply (in the light of contemporary knowledge) almost without exception to the problem.

1. Water resistance and vapor resistance must always be considered as entirely different problems. *Water is a fluid* and as such obeys the laws relating to *fluids. Moisture vapor is gaseous* in character and as such substantially obeys the laws relating to gases.
2. Practically all hygroscopic materials (of which cellulose is an example) pass water vapor rapidly but may or may not resist the passage of water in its fluid state.
3. A *continuous* film—i.e., without pinholes and other small voids—must be achieved before high moisture-vapor resistance (MVR) can be expected. Assuming that a continuous film has been attained, it does not necessarily follow that MVR has been accomplished. Generally, the result will depend on the physical and chemical properties of the film-forming substance. If hydrophillic—i.e., water loving—it is likely to prove worthless as to MVR—e.g., starch or glue films. If hydrophobic—e.g., paraffin wax—it *may* be moisture-vapor resistant (MVR) but tests are the only sound basis for conclusions.
4. Any supposed MVR films which pass any measurable quantities of air under moderate pressure should be regarded with suspicion until proved reliable.
5. Any supposed MVR materials (such as rosin or wax sizes, starch, clay, etc.) which are incorporated into a sheet of paper or paperboard during the matting of the fibers at the wet end of the paper machine are apt to prove worthless and should be considered so until tests prove otherwise.
6. While resistance to other gases might be expected to parallel water vapor resistance it should not be assumed that this is universally true. Conclusions on this point should be drawn only after careful experimental work done in a laboratory where competent personnel trained along this line is available.

Two Types of Water Vapor Resistance Tests

Regardless of conditions and methods surrounding MVR tests, there are two common approaches involving two different types of testing materials:

1. Testing of membranes of supposed MVR material.
2. Testing of packages made from supposed MVR material.

Both are analogous to corresponding tests made by the mechanical engineer prior to the design and construction of steel structures: (a) corresponds to engineering tests for tensile or compressional stress on construction materials; (b) corresponds to the tests which might be made on a model of a suspension bridge whose design had been carefully thought out, based on data corresponding to tests like Type 1. While the collection of data relating to the ability of steel to withstand various stresses and strains involves much effort, it is used as the basis for design calculations, which save a great deal of time and effort in arriving at a model which approaches requirements closely enough to justify exhaustive tests on the scale model. Meantime much time-consuming and costly work by the "cut and try" method has been eliminated through fundamental knowledge of the properties of the construction material. Obviously unsuitable materials for the job have been mentally dismissed without great expenditure of effort and time. Development of MVR packages involves analogous considerations.

Basis for Tests on Membranes

While considerable confusion is apparent in the literature, it would seem reasonably safe to conclude that the rate of water-vapor transfer through a membrane is a direct linear function of the difference in aqueous vapor pressures existing on opposite sides of the membrane. Abrams and Brabender have established (*1*) that vapor pressure gradients exist within MVR test cups containing water. The gradient is greater when highly permeable membranes are tested. The gradient is greater, when surface of water in cup is farther from the membrane and the converse is also true. These phenomena make proof of the relation between vapor pressure and MVTR difficult.

Carson (*2*) states that moisture-vapor transmission rates (MVTR) made at relative humidities below

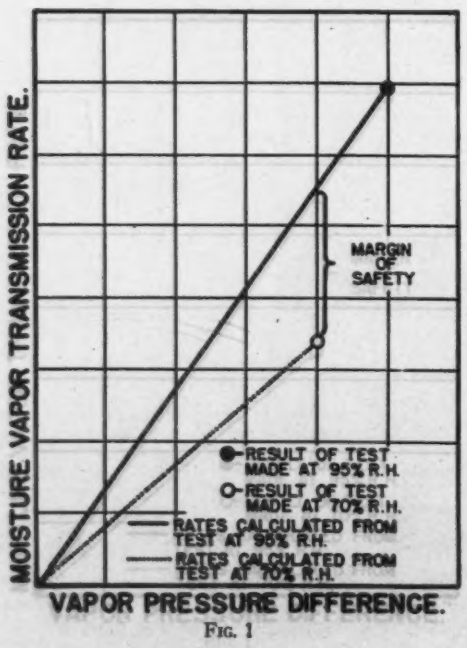
MOISTURE VAPOR TRANSMISSION RATE.
MARGIN OF SAFETY
RESULT OF TEST MADE AT 95% R.H.
RESULT OF TEST MADE AT 70% R.H.
RATES CALCULATED FROM TEST AT 95% R.H.
RATES CALCULATED FROM TEST AT 70% R.H.
VAPOR PRESSURE DIFFERENCE.

Fig. 1

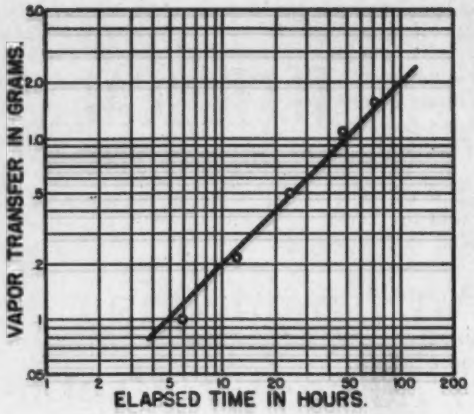

Fig. 2

70% to 80% vary directly and linearly with vapor-pressure difference. Above the 80% relative humidity testing condition he implies that the ratio between MVTR and vapor-pressure difference will be equal to or greater than the same ratio determined for the same material at lower than 80% relative humidity.

For these reasons, it appears that MVTR's determined at higher temperatures —(e.g. 100° F., 95% R.H.) can be used for calculation of MVTR's at lower vapor pressures with every assurance that the calculated result will be somewhat higher than the actual MVTR, thus introducing a factor of safety. This is shown in Fig. 1.

Since packaging materials may readily encounter in actual shipment conditions approximating saturation of surrounding air with actual condensation of atmospheric water vapor on the surface of the package, it is apparent that testing at higher humidities than 80% relative humidity is necessary and that calculation of MVTR's from these higher test moistures to lower ones is "on the safe side," and must be in order to be practical in predicting the results when unusual and infrequent severe conditions are encountered in practical transport.

Membrane Testing Methods

There are three commonly used methods for testing MVR membranes. The first (which is most likely to be theoretically accurate but least practical from a control standpoint) involves the placing of the test membrane as a septum between two passages in which circulate atmospheres of identical temperature but differing degrees of water vapor concentration. MVTR may be determined psychrometrically against time (making calculations for experimentally determined variations in vapor-pressure differential) or by holding vapor pressure constant through agency of proper dessicant substance on the "dry" chamber and gravimetrically determining the MVTR. The second, developed by Abrams and Brabender (*1*), involves the use of a small aluminum cup in which is placed a measured quantity of water and across the top of which is tightly sealed the test membrane. This assembly is placed in a constant humidity, constant temperature chamber held at relatively low vapor pressure and the loss in weight determined by successive weighings at recorded times. For problems involving the *retention* of moisture within a package this would appear to be a desirable system in view of its similarity to the practical packaging problem. For

problems involving the *exclusion* of atmospheric water vapor it would seem less satisfactory for converse reasons. The third method seems most convenient, dependable and direct in application to packaging problems involving the *exclusion* of water vapor from a packaging entity. Here, a light spun aluminum pan is filled with a dessicant (usually dehydrated $CaCl_2$) and the test membrane sealed across the top of pan with MVR face outside by a thermoplastic wax seal around the outer edge of the pan. This assembly is placed in a constant humidity-constant temperature cabinet maintained at relatively high vapor pressure. In all such cabinets air velocity across the face of test membrane should be continuous and reasonably rapid. This mechanism, details of which were perfected by Southwick (*6*) has been placed on a standardized basis. Among the desirable technical features are:

1. Relatively large test area clearly defined (accuracy).
2. Small space between membrane and dessicants (simulates packaging conditions).

The ensuing discussion contemplates a testing method similar to Southwick's as described in the foregoing paragraph.

Recording and Interpreting Results on Membrane Tests by Third Method

In this part of the discussion it is assumed that competent laboratory personnel and suitable equipment are at hand; and that samples have been properly prepared, that care has been expended to see that:

1. MVR face of membrane faces high vapor pressure atmosphere.
2. MVR membrane has been correctly sealed in cup.
3. That weighed and properly dehydrated dessicant has been placed in all test cups in proper amount.
4. That constant temperature and humidity maintained by cabinet are known and that cabinet has been running for a considerable period before placing cups containing samples under test.
5. That the time at which samples are placed on test is known and recorded in a proper notebook and various samples are numbered for identification on the test cups and that their past history and identity are known.
6. That $CaCl_2.2H_2O$ is used as dessicant and that cabinet

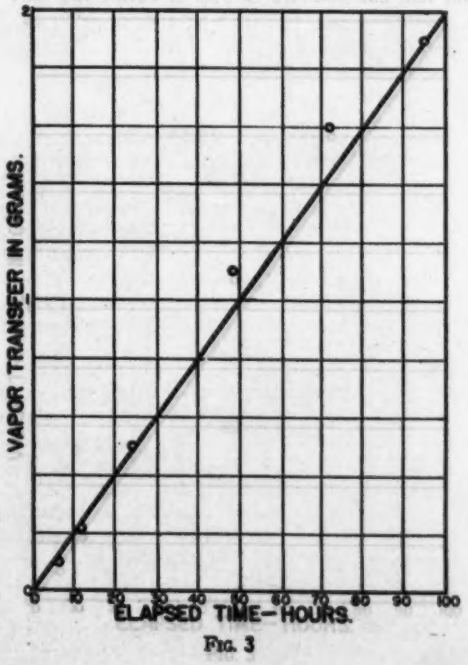

FIG. 3

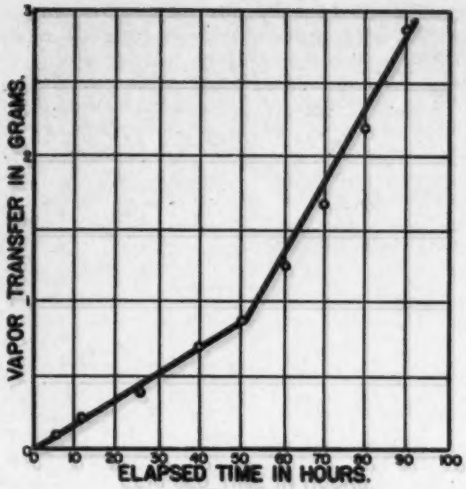

FIG. 4

temperature is at least 100° F. and 95% relative humidity. That brisk air movement is maintained within cabinet.

With these assumptions as a background, the laboratory routine is simple and direct. The recorded data for one sample will appear in the notebook somewhat as shown in Table I.

TABLE I.—SAMPLE NO. 137a

(Refer to Receival Record for Manufacture and Description)

Date	Hour	Time Elapsed, hours	Weight of Test Cup Assembly	Weight Increase, g.	Remarks
6/22/42	12 a.m.	0	151.37 Gms.	0	.....
6/22/42	6 p.m.	6	151.47 Gms.	0.10	.....
6/22/42	12 p.m.	12	151.59 Gms.	0.22	.....
6/23/42	12 a.m.	24	151.87 Gms.	0.5	.....
6/24/42	12 a.m.	48	152.47 Gms.	1.1	.....
6/25/42	12 a.m.	72	152.97 Gms.	1.6	.....
6/26/42	12 a.m.	96	153.27 Gms.	1.9	.....

It seems advisable to plot each such square array of data to permit critical study for accuracy before deriving a MVTR. The data shown in the foregoing have been plotted in Figs. 2 and 3. Figure 2 is plotted on a 3-cycle log-log coordinate paper, and Fig. 3 is the plotting of the same data on rectilinear coordinate paper. These are typical results often attained by normal laboratory technique. It will be noted that Fig. 2 shows a substantially linear trend with a slope of exactly 45°. Figure 3 shows likewise a substantially linear trend. If it is noted that the trend of data points when plotted on log-log coordinate paper departs noticeably from a 45° slope it indicates:

1. Faults in the supposed MVR material.
2. Errors in collecting data.
3. Possible need for interpretation of experimental results.

Fault (1) is evidenced by a sharp upward change in the trend of the curve which may be an indication of the physical or chemical breakdown of the MVR material (or its support). This is shown in Figs. 4 and 5. This type of result justifies the elimination of the sample and cessation of attempts to calculate a MVTR for it.

Fault (2) can sometimes be rectified by checking transcription of original laboratory notebook or the arithmetic processes thereof.

Fault (3) partakes of the nature of fault (1) but represents a change in the slope of the time *vs* moisture transmission curve which takes place usually within the first 24 hours of the test period. After

changing slope (usually upward) the ensuing data maintain a linear relation between time and moisture transmission rate throughout the balance of the test period. This is shown in Fig. 6, Curve 1. Here, the method of least squares formula may be used to advantage in determining the most nearly accurate linear relation between time and moisture transmission. The first step is to arrange the data in "square-array" in the formulas given, in which: T equals elapsed time in hours, and M equals moisture transfer in grams. The data given in the example in Table II are same as shown in Fig. 6.

TABLE II

M	=	a	+	bT	MT	=	aT	+	bT^2
.10		a		6b	.60		6a		36b
.20		a		15b	3.00		15a		225b
.27		a		20b	5.40		20a		400b
.43		a		26b	11.18		26a		676b
.66		a		36b	23.76		36a		1296b
.93		a		48b	44.64		48a		2304b
1.40		a		64b	89.60		64a		4096b
1.76		a		85b	149.60		85a		7225b
2.26		a		101b	228.26		101a		10201b
8.01	=	9a	+	401b	556.04	=	401a	+	26459b

From the totals of the terms of the two equations we thus have two simultaneous equations:

$$556.04 = 401a + 26459b \quad (1)$$

and

$$8.01 = 9a + 401b \quad (2)$$

Multiplying Equation 2 by $401/9 = 44.55$ thus:

$$8.01 = 9a + 401b$$
$$\times\ 44.55$$
$$356.84 = 401a + 17864.55b \quad (3)$$

By subtracting Equation 3 from Equation 1 thus:

$$(1)\quad 556.04 = 401a + 26459b$$
$$(3)\quad 356.84 = 401a + 17864.55b$$
$$199.20 = 8594.45b$$

Solving for b:

$$\frac{199.20}{8594.45} = b = .0231$$

Substituting the calculated value of b in Equation 2 thus:

$$8.01 = 9a + (401)\ (.0231) = 9a + 9.2631$$

and

$$\frac{8.01 - 9.2631}{9} = a - 0.1392$$

Placing the calculated values of b and a in the original type equation we have:

$$M - 0.1392 + .0231T \quad (4)$$

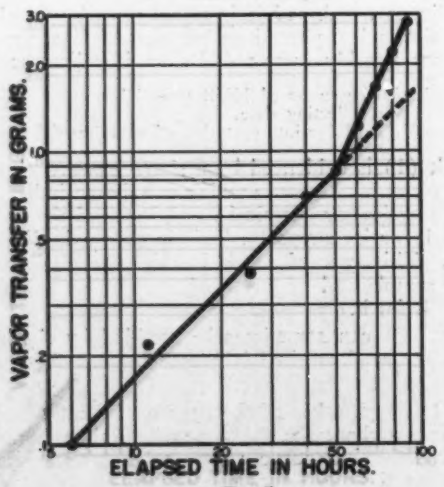

Fig. 5

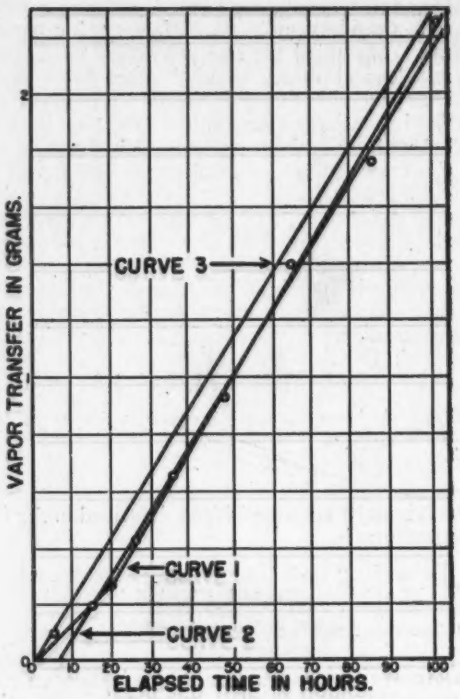

Fig. 6

Linear Trend

Equation 4 represents the linear trend in which the squares of the deviations between the trend and the recorded data are at a minimum. This curve derived by the Method of Least Squares is shown in Fig. 6, Curve 2. By referring to Curve 2, Fig. 6, it appears that the moisture-vapor transmission would be zero after 6 hours elapsed time—an obvious impossibility as shown by the experimental data recorded at 6 hours elapsed time. It would appear therefore that the sample had not reached equilibrium with the test cabinet at the time it was placed in the test cabinet. We can then alter our basic equation to make a equal o, but leaving the rate of vapor transmission as calculated. Thus our equation now becomes:

$$M = 0 + 0.0231T \quad (5)$$

or

$$M = 0.0231T \quad (6)$$

The trend line thus established is shown in Fig. 6, Curve 3. This appears reasonable and in cases where the value of a (as determined by the method of least squares) is a negative quantity, introduces a slightly more conservative interpretation of the data. As a matter of fact, the value of a thus derived is generally a positive quantity.

By reference to Fig. 6, Curve 3, it will be noted that while Curve 2 as shown is the best possible linear trend to fit the experimental data, it is parallelled by Curve 3 which is of identical slope, and hence indicates identical moisture transmission per elapsed time. Curve 3 is entirely consistent with our knowledge of the phenomena—i.e., it reads zero moisture transmission at the start of the experiment at zero time, whereas extrapolation of Curve 2 indicates a negative transmission of moisture vapor at zero time. This is an obvious impossibility. On examination it will be seen that Curve 3 is exactly higher at all points than Curve 2 by an amount equal to the value of a determined by

the method of least squares (*7*). If we now set down the experimentally determined values for M and T but increasing M by an amount equal to a thus, we have the values given in Table III.

TABLE III

Value of T	Value of M + a Corresponding
6	.2392
15	.3392
20	.4092
26	.5692
36	.7992
48	1.0692
64	1.5392
85	1.8992
101	2.3992

Appraisal of Results

When this is plotted on log-log coordinate paper (Fig. 7) it is immediately possible to appraise the reliability of experimental results on which the subsequent packaging design is to be based. Note the small bracketed measured 10% included in this chart. By comparing the vertical departures of the data points against the 10% bracket it is possible quickly to approximate maximum deviation, minimum deviation, and mean deviation. The formula for relation between M and T can then readily be used with assurance in calculating the actual MVTR as will be shown subsequently.

Calculating the Water Vapor Transmission Rates at Various Vapor-Pressure Differences

By reference to Fig. 1 and the preceding discussion in connection with Fig. 1, it will be seen that high temperatures and relative humidities in the test cabinet are essential if we are to attain a calculated series of rates which embrace a margin of safety adequately covering extreme vapor stresses. While extreme, provision must be made for them in most practical problems. The following discussion is intended to cover only membrane tests made under conditions as given in the paragraph outlined in the beginning of the section: Recording and Interpreting Results on Membrane Tests by Third Method. Adherence to these conditions is absolutely essential in obtaining a base MVTR embracing a factor of safety essential to practical use requirements.

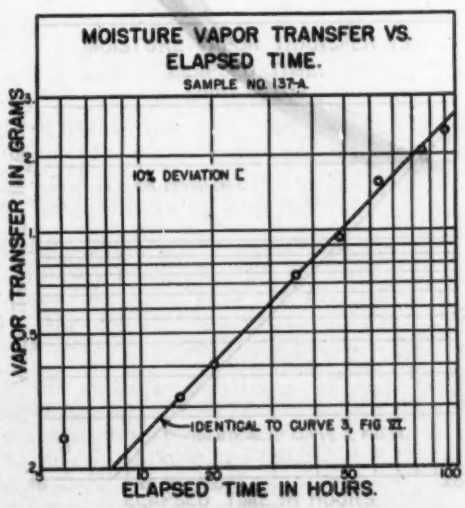
MOISTURE VAPOR TRANSFER VS. ELAPSED TIME.
SAMPLE NO. 137-A.
10% DEVIATION
IDENTICAL TO CURVE 3, FIG XI.
VAPOR TRANSFER IN GRAMS
ELAPSED TIME IN HOURS.

Fig. 7

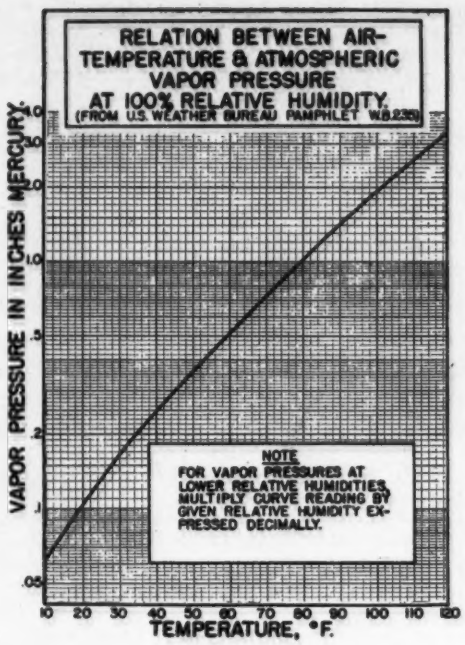
RELATION BETWEEN AIR-TEMPERATURE & ATMOSPHERIC VAPOR PRESSURE AT 100% RELATIVE HUMIDITY
(FROM U.S. WEATHER BUREAU PAMPHLET W.B.235)
NOTE
FOR VAPOR PRESSURES AT LOWER RELATIVE HUMIDITIES, MULTIPLY CURVE READING BY GIVEN RELATIVE HUMIDITY EXPRESSED DECIMALLY.
VAPOR PRESSURE IN INCHES MERCURY.
TEMPERATURE, °F.

Fig. 8

Referring to Fig. 7, the data given on Sample 137a is:

$$M = 0.0231T$$

where M equals moisture vapor transmission in grams and T equals elapsed time in hours. Further examination of the experimental data discloses that the tests in question were run on a membrane having an exposed circular area a of 10 inches diameter. Inside the test cup was $CaCl_2.2H_2O$ (obtained by holding the regular commercial $CaCl_2$ at 250°F. in an oven for 5 or 6 hours). The cabinet in which the test was run, maintained a temperature of 100°F. and relative humidity of 95%. By reference to Fig. 8 (which is a condensation of data from *(8)*) we find that the vapor pressure corresponding to these conditions is

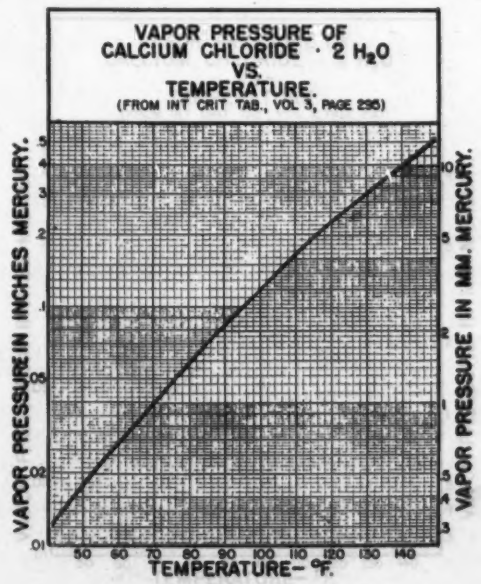
VAPOR PRESSURE OF CALCIUM CHLORIDE · 2 H₂O VS. TEMPERATURE.
(FROM INT CRIT TAB., VOL 3, PAGE 295)
VAPOR PRESSURE IN INCHES MERCURY.
VAPOR PRESSURE IN MM. MERCURY.
TEMPERATURE—°F.

Fig. 9

approximately 1.81 inches Hg. By reference to Fig. 9 (condensed from *(9)*) we find that $CaCl_2.2H_2O$ exerts a vapor pressure of approximately 0.118 inch Hg. The vapor-pressure difference between opposite sides of the membrane is therefore

1.81 — 0.118 = 1.692 inches Hg. vapor-pressure difference

With these facts in mind, let:

R = MVTR expressed in pounds per 100 sq. in. per 24 hr. at any vapor-pressure difference p
M = moisture vapor transmission in grams at time T
T = elapsed time for membrane test in hours
D = diameter of exposed test membrane in inches
A = area of exposed test membrane in sq. in = $(\pi D^2)/4$.
V_1 = higher vapor pressure in inches Hg used in membrane test cabinet
V_2 = lower vapor pressure in inches of Hg used in membrane test cup
p = any difference in vapor pressure in inches of Hg
$b = M/T$ = constant for any particular test data on membrane
c = constant expressing ratio R/p

Then:

$$R = \left(\frac{M}{T}\right)\frac{24 \times 100 \times p}{454 \times \frac{\pi D^2}{4} \times (V_1 - V_2)} =$$

$$\frac{2400\,p}{113.5 \times \pi D^2 \times (V_1 - V_2)} = b\left(\frac{21.14\,p}{\pi D^2 \times (V_1 - V_2)}\right) \quad (7)$$

Substituting experimental and instrumental data:

$$R = 0.0231\,\frac{21.14 \times p}{314.16 \times 1.81} = 0.0009\,p \quad (8)$$

and

$$\frac{R}{p} = c = 0.0009\,p \quad (9)$$

The value of c for Sample 137a in the example is, then, 0.0009. This means that, for any change of vapor-pressure difference p equal to 1 inch Hg, the moisture transmission rate R will change by 0.0009 pounds per 100 square inches per 24-hour day.

Knowing the value of c for any particular material, it is possible to calculate close approximations of the amount of water vapor which should be passed by a container of known dimensions at any given vapor-pressure differences for any period or periods of time, provided a good water vapor-resistant closure of the container has been worked out. The complete method for working such calculations will be detailed in the latter part of this paper.

Checking the Value of a Closure Method for MVR Quality

No practical result can be attained from the development of an MVR membrane until a method has been developed for substantially MVR closure of containers constructed from it. While the discussion which follows is applied specifically to the appraisal of the effectiveness of MVR closures the same principles can be applied to evaluating the effects of abrasion, flexing, low temperatures, etc., in influencing MVR films under practical transport conditions. The choice of whether the technique about to be described, or whether membrane tests can best be applied to measuring variables involved with other than closure effects, must be determined by the particular material and package. No general principles can be applied.

Before proceeding with an evaluation of closure methods, it is assumed that the previously described routine for membrane testing has been completed, and that values for M/T, R/p, R, and c have been thus fixed for the membrane under investigation.

The next step is to prepare a package from the MVR material into which can be sealed $CaCl_2.2H_2O$ by the closure method under examination. If the final package unit envisioned is relatively small and an exact duplicate can conveniently be got into the test cabinet, it is probably best to make our determinations from a package duplicating in materials, closure method, and dimensions the actual commercial package desired. If this is not practicable, judgment must be exercised in selecting a size which possesses the characteristics representing an optimum compromise between the conflicting considerations.

Let us assume that membrane 137a is the material to be used, that the final size of the package is 3 by 1 by 6 inches. In this case we can probably arrange to test an actual sample package. Such a package is made of material 137a (preferably cut from the same sample as that on which previous membrane test was run) nearly fill the package with $CaCl_2.2H_2O$, seal it under conditions approximating as nearly as possible final planned packaging procedure. The package is then placed in constant temperature-constant humidity cabinet, and data taken on it and recorded as detailed for the membrane tests for the same material. Where exacting work is indicated, the same statistical handling may be applied to these data and a value for M/T determined:

where

$\frac{M_1}{T_1}$ = value of $\frac{M}{T}$ for membrane test

$\frac{M_2}{T_2}$ = value of $\frac{M}{T}$ for package closure test

a_1 = area of membrane test in sq. in.
a_2 = total area in square inches of package tested for closure

Then

$$\left(\frac{M_1}{T_1\,a_1}\right) - \left(\frac{M_2}{T_2\,a_2}\right) = \text{loss (—) or gain (+) due to imperfections in closure} = L \quad (10)$$

and

$$\frac{L}{\frac{M_1}{T_1\,a_1}} = \text{Loss (—) or gain (+) due to imperfections in closure} = Q \quad (11)$$

If results in solving for L and Q result in positive (+) figures, the evidence implies that we have a satisfactory closure. If the results are negative (—), then we must review the closure method under careful scrutiny and determine whether improvements can be made representing results consistently attainable in production. If it is decided that improvement can be made, the routine is repeated and the new method re-evaluated. If value of Q is negative, but consideration convinces us that no improvement can be practically effected as to closure, steps then should be taken to calculate a new value for c for the material when sealed as follows:

$$\text{New } c \text{ value for material 137a in package form} = c\,(1 - Q) \quad (12)$$

Where the value of Q is positive it is recommended that the value of c determined for the material by

membrane test be used without alteration for this introduces a further factor of safety. In such a case the value of c for the membrane and the value of c for the package are identical.

In the foregoing discussion a statistical method has been developed for evaluating the MVTR for any membrane under consideration. A method has been worked out for appraising the value of a proposed package sealing method. A way of correcting the MVTR obtained on membrane tests to a new MVTR for use in practical package design has been described. Because the MVT of a package is strongly influenced by the difference in vapor pressures outside and inside of the package, it is apparent that the fundamental sorption characteristics of the enclosed product in connection with the quality of product under corresponding conditions will greatly influence the choice of a MVR material from which to construct the package. For example, imagine a food product which, when packed, might have a moisture content of 6% and which would withstand an increase of 2% moisture content to make the final moisture content 8% without deterioration in palatability or appearance. Let us further imagine that tests have shown that this food at 6% moisture content is at equilibrium, when the surrounding atmosphere is at 75° F. with relative humidity at 50%. Let us further suppose that throughout transit it is exposed only to 75° F. temperature and 50% relative humidity. Obviously, no difference in vapor pressure between inside and outside of package will exist under these conditions. On this basis, it seems reasonable to conclude that no MVR package will be needed, equilibrium at optimum moisture content for our hypothetical food being insured by the interrelated conditions postulated. Between this idealized condition, and impossibly severe conditions represented by extremely hygroscopic contained material and high vapor pressures involved with high temperatures and humidities encountered in transit, lie myriads of possible combinations representing neither extreme. Until a MVR material possessing at one and the same time a nearly perfect moisture-vapor resistance together with the lowest unit cost offered in the field is developed, it will be necessary to work out a method of selection of MVR substances which will insure adequate protection at the lowest unit cost possible for the particular problem under consideration. "Undershooting" the mark will bring forth economic losses involved with contents spoiled in transit to the consumer. "Overshooting" the mark will result in waste of MVR materials on commodities and conditions unworthy of the MVR material's capabilities.

From the broad sociological viewpoint or from the narrower competitive vantage ground a method for avoiding the creation of such economic losses seems essential.

Determining the Vapor Stresses Produced by the Product to be Packaged

The existing standard U. S. Government test for determining the moisture-free weight of dehydrated foods is as follows:

> Place a 2-gram sample of the food in a vacuum oven in which is maintained a temperature of 70° C. (158° F.) for 6 hours at a vacuum of 100 mm. Hg.

From this it will be seen that the technique involved in dealing with moisture content of foods (at least) involves considerations of oxidation and other chemical changes which may occur at elevated temperatures and which may effect experimentally obtained weights unless care is exercised to control testing conditions. While the talent and apparatus necessary are not at all beyond the reach of industrial laboratories in the medium or large sized industries, a laboratory supported by government funds or by cooperative industry groups should result in the elimination of much confusion and profitless duplication of laboratory work. Until the organization of such facilities, it is necessary to conduct tests in whatever laboratories can be made available.

Because of the slope of the sorption-time relation in hygroscopic substances exposed to atmospheric conditions requiring a large change in their existing moisture, determination of their true moisture content must be made by weighing their gross weight under the actual conditions and calculating their moisture content at those conditions from a moisure-free weight previously determined. Any attempt to place samples in a cabinet with controlled temperature and humidity until equilibrium is reached, remove from cabinet, weigh and calculate moisture content will very likely be frustrated by the extremely rapid rate of moisture loss or regain produced by the changed conditions surrounding such a weighing operation.

For this reason, our first step involves the determination of a true moisture-free weight for the substance under investigation. A regular laboratory oven is so adjusted as to maintain a temperature of 158° F. (or other determined temperature) within a small tightly rubber-corked Erlenmeyer flask. Attached to a hydraulic aspirator (or preferably other controlled source of vacuum) by means of appropriate vacuum tubing, the flask is provided with a positive pinch-cock cut off or glass ground-joint stop-cock so connected to the vacuum line that flask, cork and stop-cock can be removed from the oven and the whole assembly weighed. This assembly is placed in the oven for one hour or more, the system evacuated to 100 mm. Hg. At this point stop-cock is closed, and assembly of flask, stopper and stop-cock separated from the vacuum line and weighed. A weighed sample of the substance under investigation is then placed in the flask, stopper and stop-cock replaced in the flask. the assembly placed in the oven and the vacuum line attached. At 100 mm. Hg. pressure and 158° F. the sample remains in the oven for 6 hours. At the end of this period stop-cock is shut, vacuum line removed and the remaining assembly containing sample is weighed, and the moisture-free weight of sample is determined by weight differences. The entire assembly containing the sample is then placed in the top of a tightly sealed dessicator at room temperature containing concentrated H_2SO_4 in the lower portion. The H_2SO_4 used should have a specific gravity of not less than 1.83.

During the previously described operations, a suitable constant-temperature, constant-humidity cabinet containing a scale has been operating long enough to have reached stable conditions. Ulm *(10)* describes constructional details of a suitable cabinet. The Erlenmeyer flask containing sample is quickly placed in weighing chamber, the small door provided for the purpose is quickly and tightly sealed, and the entire sample placed on scale pan and weighed. Time and weight are both recorded in a notebook. This opera-

tion is repeated until the time-weight curve shows no further gain. Without changing temperature, the saturated-salt solution used to maintain constant humidity is removed from the system and immediately replaced by another selected so as to maintain a higher humidity at the same temperature. The previous routine of recording time and weight until equilibrium is reached is again followed, the second salt solution is replaced by a third, then a fourth, etc., until a relative humidity of 85 to 90% is reached. At this point, the fourth salt solution is replaced by the third and so on until the original salt solution is again acting. Let us assume that constant temperature has been set at 100° F. during the preceding routine. A new temperature is now set on the control (say 70° F.) and the whole cycle repeated for 70° F. isotherm. Again, the same is done for a new isotherm (say 40° F.). It is suggested that whatever cabinet design is used, two refinements will add to accuracy and convenience.

1. Tightly sealed drawers through which dessicant solutions can be quickly changed be provided for in cabinet designs.
2. A dew-point apparatus be built into the cabinet so that it can be charged with ether, operated, temperature read, and bowl observed from outside the cabinet without disturbing moisture equilibrium of cabinet. For further information on the reduction of dew point observations *see (8)*.

When all data taken at (say 3) isotherms and (say 4) humidities are taken, it is suggested that all weight observations be calculated to equilibrium moisture contents by the following formula:

$$\frac{100\ (W_w - W_D)}{W_w} = \%\ \text{moisture} \qquad (13)$$

where
W_w = observed weight of sample in humidity cabinet
W_D = observed weight of sample on removal from vacuum oven.

It is further recommended that all psychrometric observations at equilibrium be calculated to equivalent vapor pressures at their apropriate isotherms and the

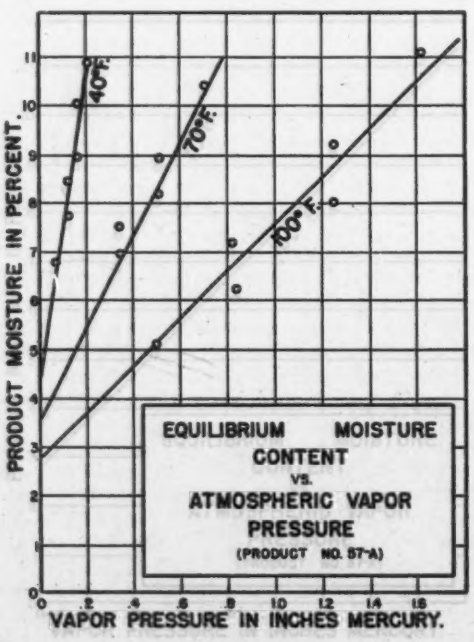

FIG. 10

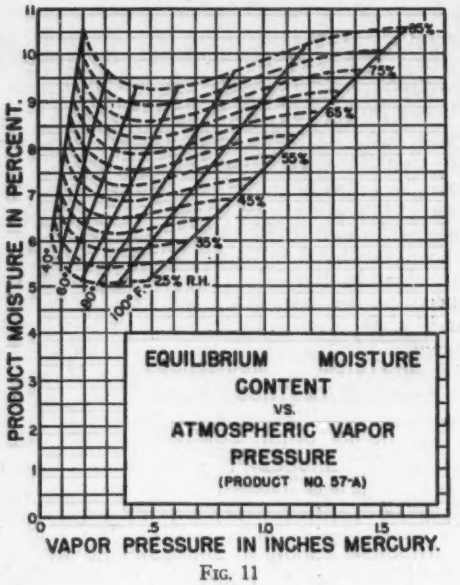

FIG. 11

whole arranged in "square-array" as shown in Table IV.

TABLE IV

At 100° F.		At 70° F.		At 40° F.	
% Moist.	Vapor Press.	% Moist.	Vapor Press.	% Moist.	Vapor Press.
5.10	0.500	6.95	.340	6.70	0.070
6.25	0.875	8.20	.500	7.70	0.120
8.05	1.265	10.50	.650	9.00	0.165
11.00	1.630	9.00	.490	10.90	0.210
9.20	1.260	7.59	.340	10.00	0.160
7.55	0.860	....	...	8.45	1.10

These data are actual figures obtained by the laboratory methods described and represent results which are typical of certain samples. By reference to Fig. 10, one sees the characteristic hysteresis which frequently occurs to cause differences between the results obtained under adsorption and those obtained from desorption cycles. The trend lines can be fitted to the data either by the method of least squares or visually as seems best under surrounding circumstances. By deriving empirical equations and plotting the values of their constants against the values of their corresponding isotherms we can then, by interpolation, map all of the territory intervening between the extremes of temperatures and equilibrium moistures on which we have experimental data as shown in Fig. 11 which is a plotting of data shown in Fig. 10 with appropriate interpolations.

At this point reflection on the foregoing pages will show that we have developed methods to measure the value of MVR materials sealed as in practice. A method has been shown for appraising some of the more obscure but vitally important properties of enclosed materials which are candidates for moisture-vapor-resistant packaging. Further consideration will show that there are other important variables which may have great influence on the practical results ensuing from a packaging design. These are:

1. Ratio between area of outer surface of small unit package and moisture-free weight of enclosed contents.
2. Ratio between area of exposed outer surfaces of an aggregate of small unit packages in a shipping container and the total moisture-free weight contained in shipper.
3. Time in transit from packing till receipt by consumer.
4. Temperature and humidity conditions, their chronological sequence, and their duration.

SOLUTION OF VARIABLES

Of these variables, the *first* is easily determined for any specified problem. The *second* rests on an intricate fabric of subordinate details almost impossible to appraise; for this reason, it is thought best to disregard this consideration since by so doing we introduce another factor of safety when the shipping container consists of an aggregate of small package units. If, however, the small unit is (in fact) the shipping container our subsequent calculations will be based on just that asumption. The *third* is readily determined by investigation which the packer and his representatives are best qualified to conduct. The *fourth* is best determined by reports from the packer. His statements as to the peregrinations of the product in time and space coupled with U. S. Government Weather Bureau data can be used to define the vapor stresses to which the package will be subjected.

It is apparent, therefore, that we can now depart from further consideration of methods for determining strengths of our materials and begin to apply them to design calculations.

Material for a Particular Packaging Problem

Let us assume that it is desired to package a material having characteristics as shown in Fig. 11. Let us further assume that the material is packed at 5% moisture and that this moisture can reach 7% without deterioration in the product's usefulness. We are told that the material has a weight of 30 lb. per cu. ft. (or 1728/480 = 3.60 cu. in. per oz.) and that the package will contain one pound net weight and will have dimensions of 5 by 1.5 by 7.75 inches. The manufacturer advises that immediately following packing the packages are subjected to the conditions given in Table V.

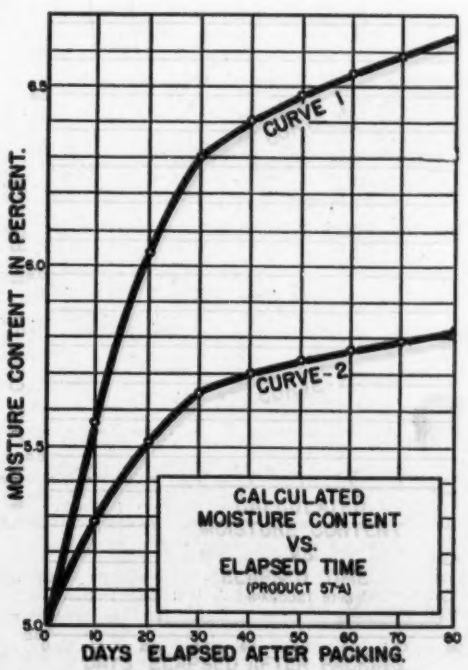

FIG. 12

TABLE V

Cycle No.	Period of Time, days	Location	Operation
1	10	New York City	warehouse
2	10	N. Y. to Chi. via train (middle west)	in transit
3	10	Chicago	warehouse
4	50	Chicago	dealers stock

This information describes our problem. We now must interpret it so as to make calculations as to whether one of our known water vapor resistant-materials will carry this product to the consumer without deterioration brought on by water vapor.

1. Re-examination of these facts will show that package area $A = 2(5\times1\ 1/2) + 2(7\ 3/4\times1\ 1/2) + 2(5\times7\ 3/4) =$ 116 sq. in.
2. Maximum allowable increase in weight due to MVT is

$$I = \left(W_p \left(1.0 - \frac{S_p}{100} \right) \times \frac{1.0}{1.0 - \frac{S_e}{100}} \right) - W_p$$

Where W_p = is the net packed weight including adsorbed moisture (S_p)
S_e = maximum allowable percentage of moisture on delivery to consumer
S_p = % of net packed weight represented by moisture

Substituting the proper values in this equation:

$$I = \left(1.0\ (1.0 - .05) \times \frac{1.00}{.93} \right) - W_p$$

$$= \frac{.95}{.93} - 1.0 = .0215\#$$

By reference to sectional U.S. Government Weather Bureau statistics, this package will be subjected to the atmospheric conditions given in Table VI during the more humid seasons and for the periods noted. We have reduced these to vapor pressure stresses by reference to *(8)* and Fig. 11.

TABLE VI

Cycle No.	Length of Cycle	Location	Storage Situation	Temp.	R.H., %	Vapor Pressure, in. Hg.
1	10	New York City	warehouse	80°F.	80	.83
2	10	N. Y. to Chicago	in transit	100°	55	1.06
3	10	Chicago	warehouse	90°	55	.79
4	50	Chicago	dealers shelf	90°	45	.64

Let us now calculate the probable change in moisture of contents of this package for Cycle 1, assuming that this package is to be made of material like Sample 137a and having a corrected *c* value of 0.0009 pounds per 100 square inch per 24 hours per 1 inch Hg vapor-pressure difference as shown previously. Accordingly, the amount of moisture pickup for Cycle 1 may be calculated:

$$I_1 = \frac{V_1 - P_1}{1.00} \times \frac{A}{100} \times c \times T \qquad (14)$$

Where V_1 = prevailing atmospheric vapor pressure outside of package during Cycle No. 1.
P_1 = equilibrium vapor pressure of enclosed material at moisture content corresponding to Cycle 1 and temperature prevailing for same period. (Refer to Fig. 12.)
A = exposed area of package surface in square inches.
c = previously determined MVTR for packaging material expressed in lb. per 100 sq. in. per 24 hr. per in. of Hg vapor pressure.
T = length of cycle in days.

Substituting the correct values in our equation:—

$$I_1 = \left(\frac{0.83 - 0.25}{1.00}\right) \times \frac{116}{100} \times 0.0009 \times 10$$
$$= 0.58 \times 1.16 \times 0.0009$$
$$I_1 = 0.006$$

This figure is somewhat higher than we would expect the actual value to be because the water vapor pressure difference $(V_1 - P_1)/100$ is calculated at the vapor pressure of the contents at a moisture content of 5%. This would be true only at the beginning of Cycle 1, for the moisture content would start rising immediately after packing thus decreasing the actual vapor pressure difference below that used in calculating I_1. Disregard of this factor, it will be seen, introduces an additional safety factor.

On the basis of the immediately preceding calculation our new moisture content for the contained material would be at end of Cycle No. 1:—

$$M_2 = \frac{S_p + 100I_1 \ldots .}{W_p + I_1 \ldots .} \qquad (15)$$

Substituting proper values we obtain

$$M_2 = \frac{5 + 0.60}{1.00 + 0.0060} = 5.56\%$$ moisture at start of Cycle 2.

Applying appropriate Equation 14 for Cycle 2 in the same way as for Cycle 1, but substituting value for product vapor pressure corresponding to 5.53% moisture content and with similar changes for the atmospheric vapor pressure prevailing in Cycle 2 we obtain:

$$I_2 = \left(\frac{1.06 - 0.58}{1.00}\right) \times \frac{116}{100} \times 0.0009 \times 10$$
$$= 0.48 \times 1.16 \times 0.009$$
$$= 0.005$$

Applying Equation 15:

$$M_2 = \frac{5 + 0.60 + 0.50}{1.00 + 0.0060 + 0.0050}$$
$$= \frac{6.10}{1.011} = 6.03\%$$

Applying Equations 14 and 15 for Cycle 3

$$I_3 = \left(\frac{0.79 - 0.50}{1.00}\right) \times \frac{116}{100} \times 0.0009 \times 10 = 0.003$$

and

$$M_4 = \frac{5 + 0.60 + 0.50 + 0.3}{1.00 + 0.0060 + 0.0050 + 0.0030} = 6.31\%$$

Again for Cycle 4 *1st 10 days*

$$I_4 = \left(\frac{0.64 - 0.55}{1.00}\right) \times \frac{116}{100} \times 0.0009 \times 10 = 0.0009$$

$$M_4 = \frac{5 + 0.60 + 0.50 + 0.30 + 0.09}{1.00 + 0.006 + 0.005 + 0.003 + 0.0009} = 6.40\%$$

For Cycle 4 *2nd 10 days*

$$I_4 = \left(\frac{0.64 - 0.56}{1.00}\right) \times \frac{116}{100} \times 0.0009 \times 10 = 0.0008$$

$$M_4 = \frac{5+0.60+0.50+0.30+0.09+0.08}{1.0+0.0060+0.0050+0.0030+0.0009+0.0008} = 6.46\%$$

For Cycle 4 *3rd 10 days*

$$I_4 = \left(\frac{0.64 - 0.57}{1.00}\right) \times 116 \times 0.0009 \times 10 = 0.0007$$

$$M_4 = \frac{5+0.60+0.50+0.30+0.09+0.08+0.07}{1.0+0.0060+0.0050+0.0030+0.0009+0.008+0.0007} = 6.54\%$$

For Cycle 4 *4th 10 days*

$$I_4 = \left(\frac{0.64 - 0.58}{1.00}\right) \times \frac{116}{100} \times 0.0009 \times 10 = 0.00062$$

$$M_4 = \frac{5+0.60+0.50+0.30+0.09+0.08+0.07+0.06}{1.0+0.006+0.005+0.003+0.0009+0.0008+0.0007+0.0006} = 6.59\%$$

For Cycle 4 *Last 10 days*

$$I_4 = \left(\frac{0.64 - 0.59}{1.00}\right) \times \frac{116}{100} \times 0.0009 \times 10 = 0.0005$$

$$M_4 = \frac{5+0.60+0.50+0.30+0.09+0.08+0.07+0.06+0.05}{1.0+0.006+0.005+0.003+0.0009+0.0008+0.0007+0.0006+0.0005} = 6.64\%$$

If the M values are recorded opposite their respective elapsed time periods a clearer picture is obtained of what can be expected with regard to the packaging material's ability to maintain the enclosed product in good condition (Table VII).

TABLE VII

Cycle no.	Elapsed Time Since Packed, days	Moisture at End of Cycle, %
1	10	5.56
2	20	6.03
3	30	6.31
4—1st 10	40	6.40
4—2d 10	50	6.46
4—3d 10	60	6.54
4—4th 10	70	6.59
5—5th 10	80	6.64

When these are plotted as shown in Fig. 12, Curve 1, it is apparent that a material like No. 137a has a good chance to fulfill the requirements imposed by these conditions. On the other hand, suppose that we had selected another material costing considerably more but having a c value of 0.00045. In that event these data may have plotted more like Curve 2, Fig. 12. While the ultimate decision on a packaging material would in all cases be based on adequate field trials, it is probable that these first trials would have been made on a material such as the hypothetical No. 137a rather than its more costly competitor.

Perhaps it will be well in concluding to refer once more to the second paragraph in this paper. Because of several minor points in the theory and mathematical handling of the subject which are open to criticism, it is hoped that those who perceive these defects will apply their criticism in the light of the purpose of this paper as set forth in that paragraph. It is recognized that a need exists for an improvement over this approach and it is hoped that this paper may stimulate superior work in this important packaging field.

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A Study of pH Factor in Hypochlorite Bleaching of Wood Pulp*

Part II.—Two-stage Treatment of Sulphite Pulp

By Ferri Casciani[1] and Gordon K. Storin[2]

Abstract

The same sulphite pulp used in the earlier work on single-stage bleaching, has been bleached by the two-stage method to a constant brightness of 82. Conditions of pH in the hypochlorite stage of the treatment have been varied to note the effect of pH on chlorine requirement, bleaching time, and on such pulp properties as bursting strength, tearing resistance, beating time, loss in brightness on fading, alpha-cellulose content, and ash content.

A comparison is made between the use of a high initial pH and a constant pH during bleaching.

The chlorinated unbleached pulp, the two-stage bleached pulp, and the single-stage bleached pulp are compared in quality.

The two earlier reports by the writers *(1, 2)* dealt with the subject of the pH factor in the single-stage bleaching of a particular west coast sulphite pulp. In the most recent report *(2)*, this pulp was bleached by the single-stage method with calcium hypochlorite solution to a brightness of 82 at varying final pH values. Data were presented to show the effect of final pH on chlorine requirement, on bleaching time, and on certain physical and chemical properties of the pulp.

The object of this paper is to report on a similar investigation made on the same sample of pulp in which the *two-stage method* of bleaching was employed. The first stage of this treatment was alike for all tests and consisted of a chlorination with 3% chlorine gas followed by a water wash (Table I). Using the chlorinated pulp as a raw material, a study was made of the pH factor in the second or hypochlorite stage of the treatment. The pH conditions during bleaching were varied and data were obtained concerning the effect of such variation on the chlorine requirement, bleaching time, and on some physical and chemical properties of the pulp.

The findings in this work, when compared with those in the earlier report *(2)*, also serve as a comparison between single-stage and two-stage bleaching of this particular sulphite pulp to an 82 brightness.

Description of Methods

Details of the Chlorination Treatment

The pulp used in this work was the same one employed in the earlier work on single-stage bleaching; namely, an air-dry unbleached west coast sulphite pulp having a permanganate number of 16.5. A 2400-gram sample of this pulp was thoroughly defibered in the laboratory beater, drained on a monel metal screen, and transferred to a rubber-lined tumbler-type chlorinator together with sufficient water of the proper temperature to give a pulp consistency of 4.0% and a temperature of 75° F.

TABLE I.—CHLORINATION TREATMENT
(Alike for all tests)

Chlorine gas added (based on air-dry pulp)	3.0%
Pulp consistency (air dry)	4.0%
Temperature—at start	75-76° F.
Temperature—at finish	77-78° F.
Time—to add gas	15 min.
Time—additional reaction	15 min.
Residual chlorine	0.21-.23%
pH—initial	7.5
pH—final	1.6

The cover was fastened on, the chlorinator rotated at 20 r.p.m., and chlorine gas from a one-pound liquid chlorine cylinder was slowly introduced through a hollow shaft by means of a hard-rubber piping connection. By properly setting up the chlorine cylinder on a balance and exercising care in the manipulation of the chlorine valve and in the weighing, a dosage of 72 grams of chlorine gas could be fed to the pulp with a maximum deviation of about 0.5 gram. The flow of chlorine was so regulated that in each case the time required to add the chlorine was approximately 15 minutes. At the end of an additional reaction period of 15 minutes the chlorinator was stopped and the batch tested for residual chlorine. The chlorinated pulp was then transferred to the monel metal screen, washed thoroughly by means of a water spray from a hose, rinsed with additional water in the beater for 5 minutes, drained again on the screen, finally washed down again with the hose spray, and pressed to about 33% consistency in a small fruit press. The pressed cake was thoroughly crumbled up and mixed and then divided into three batches, each equivalent to 800 grams of air-dry unbleached pulp.

Details of the Bleaching Treatment

Each batch of chlorinated pulp was transferred to a 6-gallon stoneware crock. The amount of chemical solutions to be added, together with the correct volume and temperature of water required to give an air-dry pulp consistency of 6% and a temperature of 105° F., were then calculated. The alkali or acid, if any, was diluted with half of the hot water required, added to the pulp, and the whole mixed thoroughly by hand using a long rubber glove. After a 10-minute period the calcium hypochlorite liquor, diluted with the remaining volume of hot water, was added to and thoroughly mixed with the pulp. The pulp was again mixed by hand each time before taking a pH or temperature reading or before removing a sample for titration.

Because of the small amount of heat of reaction between pulp and available chlorine in the two-stage method the temperature of the pulp did not show a tendency to rise at the beginning of the bleaching reaction, as it had in single-stage bleaching. Consequently, the crock was kept in a hot water bath from the very start of the bleaching treatment. The

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temperature in the bath was regulated so as to keep the bleaching temperature at 105° F. plus or minus one degree.

When the proper residual chlorine test (0.25% based on the weight of airdry pulp) was obtained, the pulp was dumped on the Monel screen, washed thoroughly and rinsed in the beater in the manner described above under chlorination treatment, and finally pressed to about 35% consistency in the fruit press.

The calcium hypochlorite employed in these tests consisted of a solution prepared from fresh bleaching powder (35.0-37.0% available chlorine content). The clear settled solution was decanted off, diluted to approximately 35 grams of *available chlorine* per liter, and an excess of hydrated lime added. A solution of uniform alkalinity (about 1.3 grams of calcium hydroxide per liter) was obtained by stirring in the excess lime and allowing it to settle overnight each time before a portion of the solution was drawn off for use in the experiments.

Tests Made during Bleaching

A close watch was kept of the pH during bleaching by means of a pH meter employing a glass electrode. Several trials in which pH measurements were made in the pulp mixture directly and in the clear filtrate from the pulp indicated no difference in the results obtained. Consequently, all measurements were made by immersing the electrodes directly in the freshly-mixed pulp.

The reaction of the pulp to phenolphthalein indicator was also noted. The indicator consisted of a solution of 2.5 grams of phenolphthalein in a liter of 50% alcohol. A few drops of the indicator were sprinkled on the surface of the freshly-mixed pulp and any color change was noted.

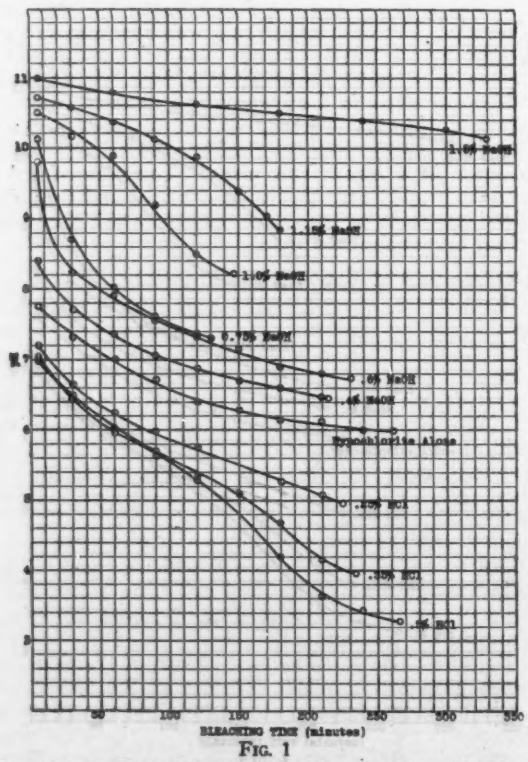

FIG. 1

Variation in pH during bleaching in bleaching to a constant brightness with the addition of varying amounts of NaOH or HCl. Constants: Air-dry pulp consistency, 6.0%; Temperature, 105° F.; Residual chlorine, 0.25%; Brightness after bleaching, 81.8-82.2

After about one hour of bleaching, tests were made regularly for residual chlorine. The test consisted of titrating 10 ml. of the filtrate from the pulp with 0.01 *N* sodium thiosulphate solution using an excess of KI in the sample, acidifying with acetic acid, and adding starch indicator near the endpoint in the usual manner.

Tests Made on the Bleached Pulp

Handsheets of the pulp were made as soon as the pulp was washed. These handsheets were allowed to dry overnight (approximately 18 hours) in an air-conditioned room at 72° F. and 50% relative humidity. The rightness value was then determined on a reflectometer[3] using the No. 1 filter in the standard manner.

The fading test consisted of exposing a handsheet of the pulp for a period of two hours at a distance of 16 inches from a 250-watt type H-5 mercury lamp. The same paper tabs used in obtaining the brightness value of the unfaded sample were used in this test. To avoid any error due to the fading which takes place normally in the sheet on standing, the fading test was run immediately after the original brightness determination.

In running strength tests, a 400-gram (air dry) sample of the pulp was beaten in the 1½-pound laboratory beater using the 4500-gram weight on the bedplate. Freeness tests were made on a freeness tester[4] at 15-minute intervals during the beating. Handsheets made at these same intervals were tested in the moisture-free condition for bursting strength and tearing resistance. Values for freeness are expressed in "per cent freeness" (the reciprocal of "beating degree"), bursting strength in "points per 100-pound ream," and tearing resistance in "grams per 100-pound ream."

Tests for ash content and alpha-cellulose content were run according to the TAPPI Standard.

Bleaching to a Constant Brightness at Various Final pH Values

Description of Experiments

The conditions which were held constant in all tests were pulp consistency, temperature, residual chlorine, and brightness after bleaching (Table II). By adding various amounts of sodium hydroxide or hydrochloric acid to the pulp before the addition of the calcium hypochlorite solution, a total of 10 experiments were performed at final pH values varying from 3.3 to 10.1 (Fig. 1). In running these tests, it was necessary to adjust the amount of *available chlorine* added to the pulp by trial and error until in each case a bleached pulp of 82 brightness was obtained.

Observations

(1) *pH During Bleaching:* Treatment of the chlorinated pulp with hypochlorite alone gave an initial pH (reading taken 5 minutes after the addition of hypochlorite solution) of 7.75 and a final pH of 6.0.

By using NaOH in amounts varying from 0.4 to 1.5%, the final pH increased gradually to a maximum of 10.1, while the initial pH ranged from 8.4 to 11.0.

The use of 0.25, 0.35, and 0.50% hydrochloric acid gave final pH values of 5.0, 4.0, and 3.3, respectively. The initial pH values, however, showed little

[3] General Electric.
[4] Schopper-Riegler.

TABLE II.—BLEACHING TO A CONSTANT BRIGHTNESS AT VARIOUS FINAL pH VALUES

Constants: Air-dry pulp consistency 6%
Temperature ..... 105° F.
Residual chlorine 0.25%
Brightness after bleaching 81.8-82.2

Test	% NaOH or HCl added	% Available chlorine added	Time, hours	Final pH	Brightness obtained
226B	0.50% HCl	2.90	4.45	3.28	81.8
311	0.35% HCl	2.40	4.00	3.96	81.8
227	0.25% HCl	2.25	3.75	4.96	82.1
225B	none	2.40	4.37	6.00	81.9
309	0.40% NaOH	2.40	3.58	6.45	82.2
210	0.60% NaOH	2.35	3.87	6.73	81.8
316	0.75% NaOH	1.95	2.17	7.30	81.9
212	1.00% NaOH	1.75	2.45	8.21	81.8
304	1.15% NaOH	1.80	3.00	8.85	82.2
313A	1.50% NaOH	2.00	5.50	10.13	82.0
Chlorinated only:					
206	.....	....	....	....	36.4

variation, the values being 7.2, 7.05, and 7.0, respectively.

It was noted that considerably less alkali or acid was required to bring about a given change in pH in two-stage bleaching than in single-stage. For example, to obtain a final pH of 8.15 in the single-stage method, the amount of NaOH required was 2.25%. In the case of the chlorinated pulp, to obtain practically the same final pH (8.21) only 1.0% NaOH was required. Likewise, in obtaining a final pH of 3.95 in single-stage bleaching, 1.0% of HCl was required; in the two-stage method it took only 0.35% HCl to reach the same final pH.

It was found that phenolphthalein indicator behaved in much the same manner as it had in the previous work in which the pulp was bleached to the same brightness by the single-stage method. While phenolphthalein normally gives a pink reaction only at pH values of 8.3 and over, when the indicator solution was applied to the pulp mixture during bleaching a pink color was obtained at all pH values above approximately 6.8. At 6.9-7.0 a faint pink color was obtained. With increasing pH, the color became deeper ranging from light pink to bright red. The point of color change appears to be related in some manner to the brightness to which the pulp is being bleached and is the same whether the single-stage or two-stage treatment is used.

(2) *Chlorine Requirement:* The relationship between chlorine requirement and final pH is shown by curve A in Fig. 2 and also in Table II. (Curve C represents the single-stage chlorine consumption and is reproduced in this figure to facilitate comparison.) Because of the trial-and-error nature of these experiments, which made it necessary often to run several trials with varying amounts of available chlorine before a pulp of the desired brightness was obtained, the figures for chlorine requirement which were used in plotting these curves are known to be accurate within less than 0.05% available chlorine on the air-dry pulp basis. The effect of pH on chlorine consumption in the second stage bleach is much the same

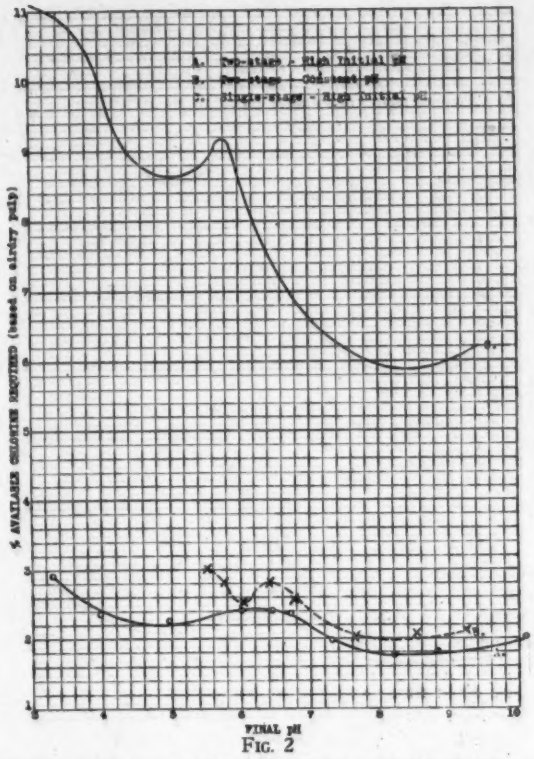
A. Two-stage - High initial pH
B. Two-stage - Constant pH
C. Single-stage - High initial pH
% AVAILABLE CHLORINE REQUIRED (based on air-dry pulp)
FINAL pH

FIG. 2

Variation in the amount of available chlorine required in bleaching to a constant brightness at varying final pH values.
Constants: Air-dry pulp consistency, 6.0%; Temperature, 105° F.; Residual chlorine, 0.25%; Brightness after bleaching, 81.6-82.2

as in single-stage bleaching. The main point of difference seems to lie in the shape of the hump in the center of the curve. The peak of the hump again occurs approximately at the point representing the test in which hypochlorite alone was used. However, the drop in chlorine requirement on either side of this point appears to take place more gradually than in single-stage bleaching. In addition, the percentage of variation in chlorine requirement is somewhat less in the second-stage bleach.

Using hypochlorite alone, 2.4% available chlorine was required to obtain an 82 brightness. By adding sufficient NaOH to increase the final pH to about 8.5, the chlorine requirement was reduced to a minimum of 1.75%. A further increase in final pH resulted in a gradual increase in chlorine requirement.

When the final pH was lowered to about 5.0 by the addition of HCl, the amount of available chlorine required 2.2%. Additional acidification resulted in an increase in chlorine requirement to a figure of 2.9% at a final pH of 3.3.

TABLE III.—QUALITY OF PULP BLEACHED TO A CONSTANT BRIGHTNESS AT VARIOUS FINAL pH VALUES

Test	Final pH	Loss on fading	Alpha-cellulose, %	Ash, %	Beating time to 75% Freeness	Beating time to 50% Freeness	Bursting strength at 75% Freeness	Bursting strength at 50% Freeness	Tearing resistance at 75% Freeness	Tearing resistance at 50% Freeness
226B	3.28	6.2	81.09	.15	17	32	97	105	79	72
311	3.96	7.0	83.06	.17	19	34	101	107	81	76
227	4.96	7.3	83.42	.18	18	37	100	109	92	83
225B	6.00	6.5	83.95	.18	17	36	100	105	84	81
309	6.45	5.3	86.01	.20	21	39	99	108	86	83
210	6.73	4.7	86.24	.24	18	40	94	103	85	78
316	7.30	4.6	87.24	.29	23	45	104	108	95	88
212	8.21	3.6	87.37	.39	26	49	99	103	94	85
304	8.85	3.6	87.31	.38	21	47	99	112	99	91
313A	10.13	3.4	87.29	.41	23	43	99	109	93	83
Chlorinated only:										
206	...	..	87.82	.42	21	44	97	109	98	91

(3) *Bleaching Time:* The curves in Fig. 3 illustrate the rate at which available chlorine was consumed by the pulp under three widely different conditions of pH. These curves are similar to those obtained in the single-stage work and are characterized by a rapid consumption of available chlorine at the beginning of the bleaching period, followed by a definite slowing down of the reaction as the endpoint is approached.

The relationship between bleaching time and final pH is shown by curve A in Fig. 4. The decided hump in the time curve, which coincides with the hump in the chlorine requirement curve, comes to a maximum at the point where hypochlorite alone was added to the pulp (final pH 6.0). As the final pH was lowered, the bleaching time dropped from 4.3 hours to a minimum of 3.7 hours at pH 5.0, beyond which the time again increased.

The important difference between this curve and curve C, which represents the time curve for the single-stage bleach, lies in the section of the curve where the final pH values were increased by the addition of NaOH to the pulp. In the second stage bleach, the point worthy of note is that, by adding sufficient alkali to raise the final pH from 6.0 to about 7.5, *the bleaching time was shortened by 50%.* (The use of this same final pH in the single-stage method had resulted in *an increase of 80% in the bleaching time.)* As the final pH was increased above 7.5 the time increased, at first slowly, up to a final pH of about 8.5, and then more sharply at the higher pH values. Obviously, from the practical point of view, these facts regarding the relationship between final pH and bleaching time are of considerable importance.

(4) *Pulp Strength:* The effect of final pH on the strength and beating characteristics of the pulp are shown by the curves marked A in Fig. 5 and by the data in Table III. It is apparent that when the two-stage method was used, the bursting strength of the pulp was little affected by change in final pH, although there can be detected a tendency toward slightly lower

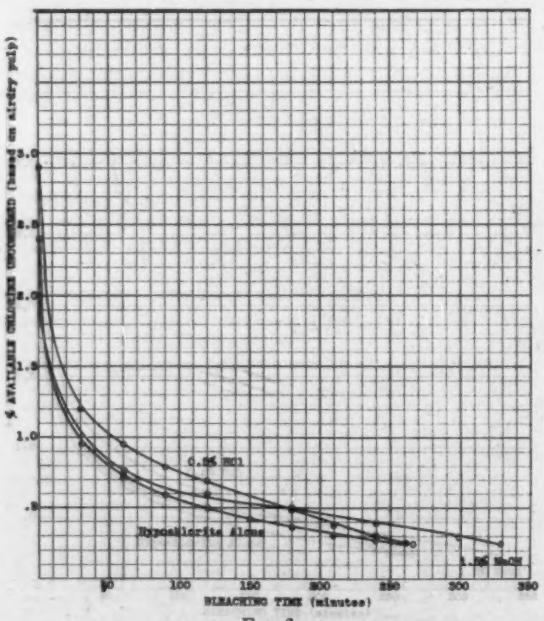

FIG. 3

Effect of HCl and NaOH on the rate of consumption of available chlorine in bleaching to a constant brightness.
Constants: Air-dry pulp consistency, 6.0%; Temperature, 105° F.; Residual chlorine, 0.25%; Brightness after bleaching, 81.8-82.2

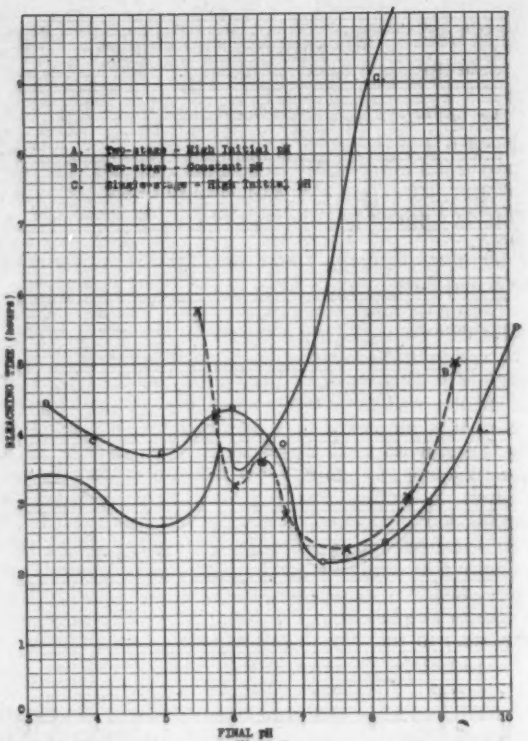

FIG. 4

Variation in bleaching time in bleaching to a constant brightness at varying final pH values.
Constants: Air-dry pulp consistency, 6.0%; Temperature, 105° F.; Residual chlorine, 0.25%; Brightness after bleaching, 81.8-82.2

values at a final pH of about 6.0 and again at the low pH end of the curve.

The tearing resistance appears to be more sensitive to pH conditions. Here there is a definite dip in the curve at a final pH of about 6.25 and a marked decrease in strength as the final pH dropped much below 5.0. The best tearing strength was obtained in the final pH range of about 8.0 to 9.0. The strength appeared to drop somewhat as the final pH rose above 9.0.

The use of NaOH in the bleaching operation resulted in an increase in the beating time required to arrive at a freeness of 50%. At a final pH of 8.25 the beating time was 36% longer than at a final pH of 6.0. At the lower pH values, the beating time did not appear to be materially affected down to a final pH of about 4.5. Below this point the beating time gradually became shorter.

In general, it may be said that the pulp of best strength was obtained in the final pH range of 7.5-9.5. In single-stage bleaching the poor strength obtained in this pH range (as shown by the C curves in Fig. 5) can possibly be attributed to the abnormally long bleaching periods which were required.

(5) *Alpha-Cellulose Content:* The results of the alpha-cellulose determinations are listed in Table III and plotted graphically in Fig. 6. By comparing curve A (two-stage bleached pulp) with curve C (single-stage bleached pulp), it will be noted first of all that both curves have a similar shape. The two-stage bleached pulp gave a maximum alpha content of 87.3-87.4% in the final pH range of 7.3 to 10.1. Between final pH 6.0 and 7.0 there was a sharp drop in alpha content to a value of 84.0% at a final pH of 6.0. In the final pH range of 4.5 to 5.75, the alpha-cellulose

content remained practically unchanged at a figure of about 83.5%. Further acidification then resulted in a rapid drop to a figure of about 81.0% at a final pH of 3.3.

At corresponding final pH values, the two-stage bleached pulp showed an appreciably higher alpha content than the single-stage bleached pulp. The comparative values for alpha content at a final pH of 8.0 were 87.4% and 83.8%, respectively. In the final pH range of 3.0 to 4.5, the drop in alpha content was much more severe in the case of the single-stage bleached pulp.

An alpha-cellulose determination made on the pulp after chlorination gave a figure of 87.8% (correction for residual lignin would no doubt reduce this value slightly). In view of the fact that a maximum value of 87.4% was obtained for the bleached pulp, it appears that bleaching this pulp to a brightness of 82 by the two-stage method under optimum pH conditions did not materially lower the alpha-cellulose content.

(6) *Ash Content:* At final pH values of 6.0 and lower, the ash content appeared to hold at a uniform minimum figure of about 0.18% (Fig. 7). As NaOH was added to the pulp, the ash content rose to a value of about 0.40% at a final pH of 8.0, beyond which the ash content remained the same.

Comparing these results with curve C (single-stage bleached pulp), we find that the principal difference is in the amount of ash present. Single-stage bleaching gave a higher ash content, especially so with increasing final pH.

(7) *Fading Characteristics:* In general, the pulp bleached at the higher final pH values gave the least amount of fading (Fig. 7). When hypochlorite alone was used (final pH of 6.0), the fading amounted to

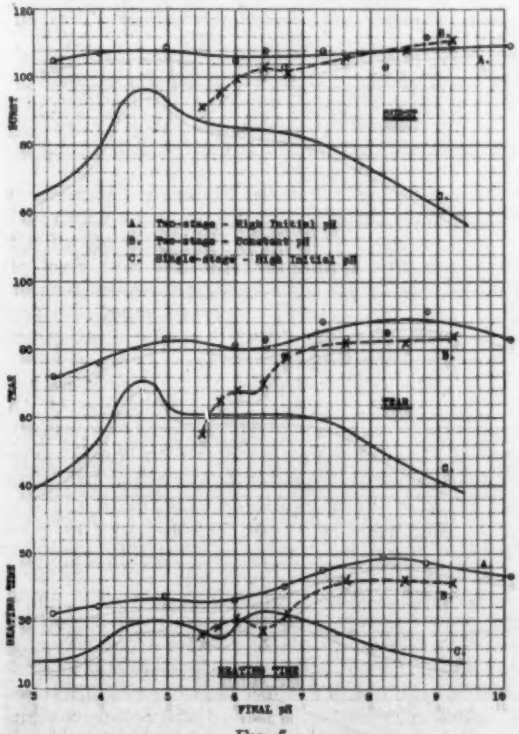

FIG. 5

Strength and beating characteristics of the pulp when bleached to a constant brightness at varying final pH values.

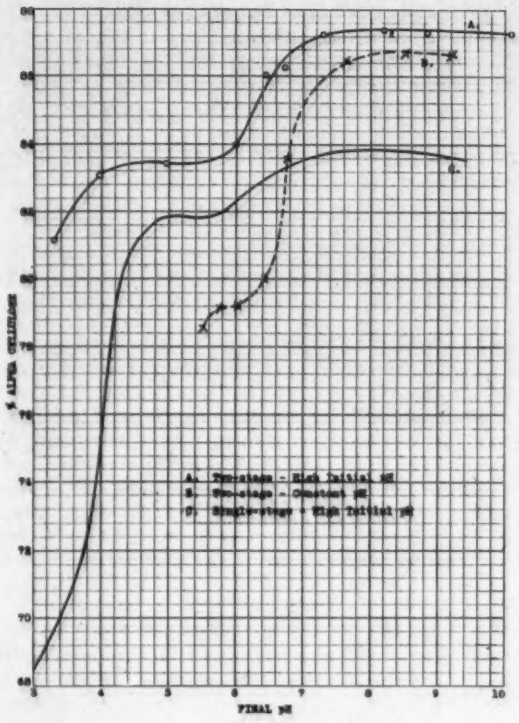

FIG. 6

Alpha-cellulose content of the pulp when bleached to a constant brightness at varying final pH values.

6.5 points. The use of NaOH reduced the fading to 4.0 points at a final pH of 7.75 and to 3.4 points at a final pH of 10.1.

The use of HCl increased the fading to 7.3 points at a final pH of about 4.5 from which point it dropped back to 6.1 points at 3.3 pH.

By referring to curve C it will be recalled that in single-stage bleaching the effect of pH on fading was almost the reverse. The most stable color was obtained when the final pH was less than 5.75, increasing the final pH to about 7.0 resulted in a considerable increase in fading.

Bleaching to a Constant Brightness at Various Average pH Values

As explained above, in the experiments just described the pH during bleaching was varied by the addition of acid or alkali to the pulp before the addition of the hypochlorite solution. In this way, the final pH of bleaching was varied to give values ranging from 3.3 to 10.1. Nothing was done to alter the normal course of the pH during bleaching, with the result that the pH curves all showed a more or less pronounced downward trend. The initial pH values which ranged from 7.0 to 11.0 were from one to nearly four pH units higher from the final pH values.

The above method of altering the pH of bleaching is the one which lends itself most satisfactorily to practice on a commercial scale. Any procedure requiring a *constant pH* throughout the bleaching operation would necessitate the use of special equipment for automatic pH control and of bleaching equipment designed to provide sufficient agitation for the prompt and thorough mixing of small amounts of alkali with the stock throughout the bleaching treatment. Equipment of this type is normally avail-

TABLE IV.—BLEACHING TO A CONSTANT BRIGHTNESS AT VARIOUS AVERAGE pH VALUES

Constants: Air-dry pulp consistency 6%
Temperature ..... 105° F.
Residual chlorine 0.25%
Brightness after bleaching 81.6-82.2

Test	NaOH or HCl added at start, %	NaOH added during bleaching, %	Available chlorine added, %	Time, hours	Average pH	Brightness obtained
423	1.00% HCl	0.69	3.00	5.75	5.51	81.9
428	1.00% HCl	0.78	2.80	4.27	5.76	81.7
408	0.75% HCl	0.58	2.50	3.25	6.03	81.8
413	0.80% HCl	0.78	2.80	3.62	6.42	81.7
331	0.50% HCl	0.63	2.55	2.83	6.77	81.6
319	none	0.35	2.00	2.35	7.65	81.6
402	0.40% NaOH	0.50	2.05	3.08	8.54	82.2
326	0.50% NaOH	0.65	2.10	5.00	9.25	82.0
Modified procedure:						
415	0.75% NaOH	0.12	1.95	2.67	8.00*	82.0

* After 1¼ hours of bleaching.

able and it is possible that the pH of bleaching can be kept more or less constant at a specified value should it prove advantageous to do so. For this reason, it was felt desirable to extend this study to include a group of tests in which the bleaching was performed under conditions of constant pH. The results of these tests compared with those in which the "high initial pH" conditions were used, should lead to some interesting conclusions.

Descriptions of Experiments

Sufficient NaOH or HCl was added to the pulp at the start to give the desired pH upon addition of the hypochlorite solution. Thereafter, NaOH in the form of a 5% solution was added in small amounts at frequent intervals to keep the pH as close as possible to the desired figure. Measurements of pH were made before and after every addition of alkali and these points are plotted in Fig. 8 to show the extent of variation in pH during bleaching.

As in the previous work, the factors of pulp consistency, temperature, residual chlorine, and brightness after bleaching were held constant in all tests. Again, in each case the correct available chlorine dosage to obtain a pulp of 82 brightness was arrived at by trial and error methods. Experiments were run at eight different pH values in the range of 5.5 to 9.25. Data covering these experiments are listed in Table IV.

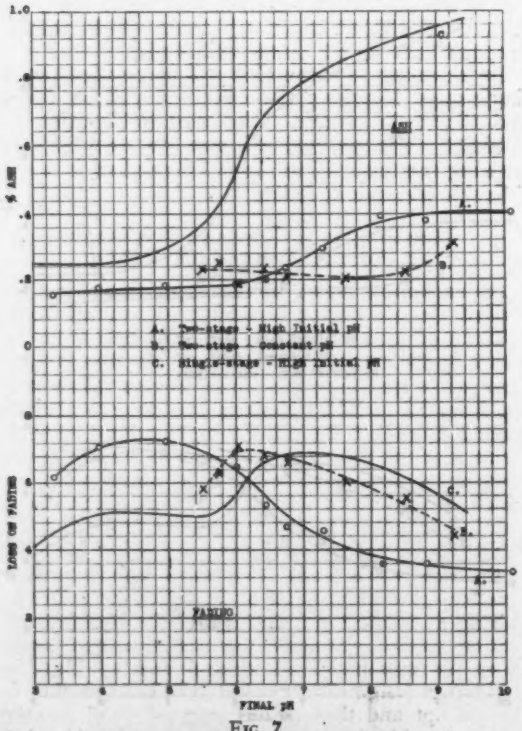

Fig. 7

Ash content and fading characteristics of the pulp when bleached to a constant brightness at varying final pH values.

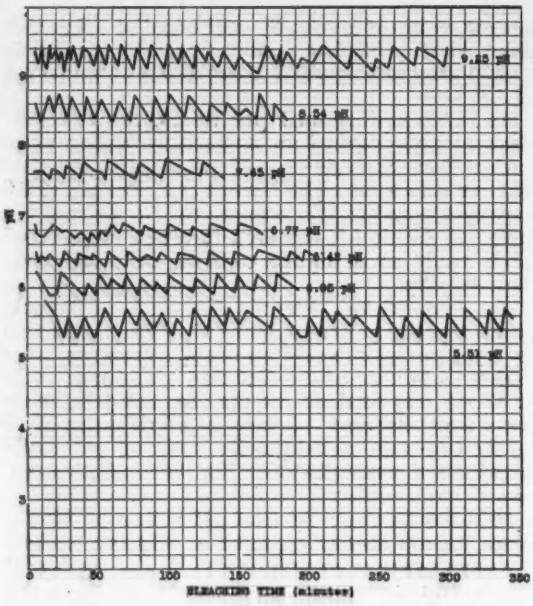

Fig. 8

Variation in pH during bleaching in bleaching to a constant brightness at various average pH values.

Observations

(1) *pH During Bleaching:* It was found that, by careful work, the pH could be held fairly close to the desired figure. At those pH values farthest from neutral, the variation in pH was greatest (Fig. 8). The maximum pH variation ranged from a low of 0.22 in the test averaging 6.42 pH to a high of 0.55 in the test averaging 5.52 pH. On the alkaline side, the maximum variation did not go above 0.40.

The reaction to phenolphthalein indicator was found to be the same as in the other tests. At a pH of about 6.9, a faint pink color reaction was obtained. As the pH rose above this point, the pink color became more pronounced. Below a pH of 6.9 no color reaction was discernible.

(2) *Chlorine Requirement:* Curve B in Fig. 2 shows the effect of pH on the second-stage chlorine requirement. (In comparing curves A and B, it should be kept in mind that B is plotted against *average pH* while A is plotted against final pH which naturally is a lower figure than the actual pH during the major portion of the bleaching cycle.) It is apparent, first of all, that B is much the same type of curve as A. However, the chlorine requirement was higher throughout the entire curve when a constant pH was used. The minimum chlorine requirement was 1.95% at a pH of about 8.25, as compared with a minimum requirement of about 1.75% when a high initial pH was used. Likewise, the peak of the hump in the curve, which occurs at a pH of 6.4, shows a chlorine demand of 2.8% as compared with only 2.4% in the earlier group of tests.

Inasmuch as curve B represents the chlorine requirement at various constant pH values, it should be of interest to compare these results with those of Samuelsen *(3)*. In treating an easy-bleaching sulphite pulp by the single-stage method with 3.55% of available chlorine (sodium hypochlorite solution) at 2% consistency and 25° C. and at various buffered pH values, Samuelsen found that in drawing a curve of the amount of available chlorine consumed by the pulp after a given reaction time (½, 4, 6, and 24 hours), there was a definite hump in the curve at pH 6.5-7.0. He also found that, in a series of blank tests in which no pulp was present, a similar hump with its peak at about 6.5 pH occurred in the chlorine decomposition curve. In the blank test, the increased decomposition at 6.5 pH was accompanied by an increase in chlorate formation. However, when pulp was present no such increase in chlorate content was found. From these findings, Samuelson reasoned that the increased "potentiality for chlorate formation" exhibited by the hypochlorite solution alone at pH 6.5 was somehow responsible for the *increased rate of reaction* between pulp and available chlorine at approximately this same pH value.

In this present study, in which all pulps were bleached to the same degree of brightness, a similar hump was found in the chlorine requirement curve, indicating a *decrease in bleaching efficiency* at 6.5 pH. The remarkable similarity between this curve and Samuelsen's blank curve, both displaying a hump with its maximum at a pH of about 6.5, would logically lead to the conclusion that the increased tendency of hypochlorite solution to form chlorate at this point is in some way connected with the decreased bleaching efficiency at this same pH.

(3) *Bleaching Time:* As in the case of the chlorine requirement curves, the bleaching time curve (Fig. 4) again resembles closely the curve for the tests in which a high initial pH was employed. The hump in the time curve reaches a maximum at pH 6.4, again coinciding with the hump in the chlorine requirement curve. The minimum bleaching time was 2.35 hours at a pH of 7.5, which compares with a minimum of 2.15 hours at a final pH of about 7.5 in the earlier tests.

(4) *Pulp Strength:* The B curves in Fig. 5 differ from the A curves mainly in the more pronounced drop in the strength of the pulp when the bleaching was carried out at the lower constant pH values. At a pH of 7.5 and over the bursting strength was about the same in the two groups of tests. In the case of the tearing strength, the maximum values were a little lower when a constant pH was employed. In line with this, the maximum beating time was somewhat shorter in the latter case.

The indications are, therefore, that the use of a high initial pH is somewhat beneficial insofar as the strength of the pulp is concerned.

(5) *Alpha-Cellulose Content:* The general effect of the pH of bleaching on the alpha-cellulose content of the pulp was much the same as when a high initial pH was used (Curves A and B, Fig. 6). However, just as in the case of the strength tests, it will be noted that considerably more degradation resulted from bleaching in the lower range of pH's. Even under optimum pH conditions (8.0 and above), the use of a constant pH gave lower values than the other method (86.7% as compared with 87.4).

Here again, it appears that the use of a high initial pH in the second stage of the bleaching treatment reduces the destructive effect of the hypochlorite solution on the cellulose fiber.

(6) *Ash Content:* The ash content in the pH range of about 5.5 to 8.5 remained nearly constant at a value of 0.20-0.23%. Above pH 8.5 the ash content rose sharply to reach a figure of 0.31% at pH 9.25. By comparing curve A with curve B, it appears that the use of a high initial pH resulted in the increase in ash taking place at a final pH of 6.5 as compared with a pH of 8.5 when a constant pH was used.

(7) *Fading Characteristics:* The fading curve again shows a trend similar to that observed when a high initial pH was used. The maximum fading took place at a pH of about 6.0. However, the drop in fading with increase in the pH of bleaching was not so sharp with the result that, at the higher pH values, the pulps were not so stable in color as those bleached under conditions of high initial pH.

Modified Procedure

An additional test was run in which the high initial pH was permitted to drop to a pH of 8.0, at which point it was kept constant by the addition of small amounts of caustic soda. In running this test (No. 415, Table IV), the conditions at the start were identical with those in Test 316 which gave a final pH of 7.3.

A comparison of these two tests showed that there was no advantage to be derived from such a modification in procedure. Holding the pH at 8.0 after the first 1¼ hours of bleaching resulted in an increase in bleaching time of 23%, very slight increases in brightness and alpha cellulose, and also slight increases in ash and fading.

High Initial pH Versus Constant pH

In Table VI a tabulation has been made of three different second-stage bleaching procedures. Method "X" represents the procedure in which hypochlorite alone was added to the pulp. In "Y", 0.8% NaOH is added at the start to give an initial pH of 10.2 and a final pH of 7.5. In "Z" the pH was held constant at an average value of 7.65. Each of the last two procedures was chosen as representing the conditions which gave approximately the optimum results in each method of controlling the pH of bleaching.

TABLE V.—QUALITY OF PULP BLEACHED TO A CONSTANT BRIGHTNESS AT VARIOUS AVERAGE pH VALUES

Test	Average pH	Loss on fading	Alpha-cellulose, %	Ash, %	Beating time to 75% Freeness	Beating time to 50% Freeness	Bursting strength at 75% Freeness	Bursting strength at 50% Freeness	Tearing resistance at 75% Freeness	Tearing resistance at 50% Freeness
423	5.81	5.8	78.53	.23	13	26	89	91	62	55
428	5.76	6.3	79.13	.25	13	28	91	93	75	65
408	6.03	7.1	79.20	.18	17	31	99	99	75	68
413	6.42	6.8	80.00	.23	16	27	98	103	73	70
331	6.77	6.6	83.58	.21	15	32	99	101	82	78
319	7.65	6.0	86.46	.20	20	42	102	106	91	82
402	8.54	5.5	86.68	.22	21	42	104	108	92	82
326	9.25	4.4	86.65	.31	21	41	105	111	90	84
Modified procedure:										
415	8.00	5.1	87.34	.31	22	41	104	111	96	90

The advantages of "Y" over the other methods are several: (1) shortest bleaching time, (2) least amount of fading, (3) highest alpha-cellulose content, (4) best strength and resistance to beating. The chlorine requirement is also lowest; however, from the angle of chemical cost, the saving in chlorine is offset by the cost of alkali required. A possible disadvantage lies in the slightly higher ash content.

Method "Z" in which the pH was held constant, has the following disadvantages when compared with "Y": (1) 10% longer bleaching time, (2) 50% more fading, (3) slightly lower alpha content and tearing resistance.

Quite definitely the best results were obtained when the method employing a high initial pH was used. It is fortunate that this should be so since in mill practice such a procedure for controlling the pH of bleaching is much more easily carried out than a procedure requiring the maintenance of a constant pH.

TABLE VI.—COMPARISON OF SECOND-STAGE BLEACHING PROCEDURES

Constants: Air-dry pulp consistency	6%
Temperature	105° F.
Residual chlorine	0.25%
Brightness after bleaching	81.6-81.9

	X	Y	Z
NaOH added—at the start	none	0.80%	none
NaOH added—during bleaching	none	none	0.35%
Available chlorine required	2.40%	1.85%	2.05%
Initial pH	7.75	10.2	7.65
Final pH	6.00	7.5	7.65
Bleaching time (hours)	4.3	2.15	2.35
Ash, %	.18	.32	.21
Loss on fading	6.4	4.1	6.1
Alpha-cellulose, %	84.0	87.3	86.5
Burst—at 75% freeness	99	99	102
Burst—at 50% freeness	106	107	105
Tear—at 75% freeness	85	94	91
Tear—at 50% freeness	80	86	82
Beating time—to 75% freeness	18	24	20
Beating time—to 50% freeness	36	46	42

Single-Stage Versus Two-Stage Bleaching

Comparative Chemical Requirement

The difference between the chlorine requirement in the single-stage bleaching and in the two-stage bleaching of this particular sulphite pulp to an 82 brightness is dependent, first of all, on the pH conditions employed in each method. Table VII lists comparative data of a single-stage and a two-stage bleach. The single-stage procedure is the one in which the pulp is treated with hypochlorite solution alone. This was chosen for comparison because it represents the usual practice in single-stage bleaching. The two-stage procedure chosen for comparison is the one

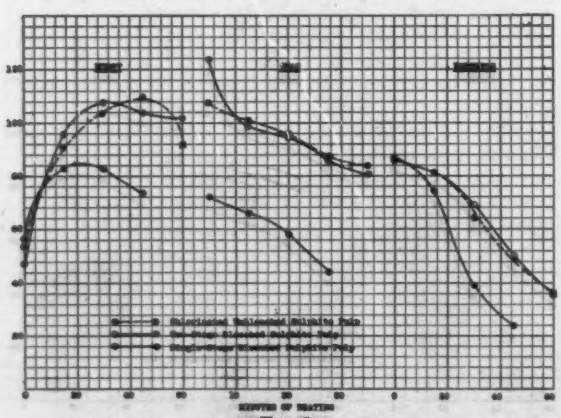

FIG. 9

Comparative strength and freeness characteristics of (a) the chlorinated unbleached pulp, (b) the two-stage bleached pulp, (c) the single-stage bleached pulp.

TABLE VII.—COMPARISON OF SINGLE-STAGE AND TWO-STAGE BLEACHED PULPS

	I Single-stage	II Two-stage
Hypochlorite Stage		
Initial pH	8.3	10.2
Final pH	5.75	7.5
Bleaching time	3.63 hrs.	2.15 hrs.
Chemicals Required		
Chlorine	9.15%	4.85%
Hydrated lime *	11.0%	2.2%
NaOH	.....	0.8%
Pulp Properties		
Brightness	81.9	81.9
Loss on fading	5.1	4.1
Alpha-cellulose content	81.8%	87.3%
Ash content	0.42%	0.32%
Burst—at 75% freeness	80	99
Burst—at 50% freeness	84	107
Tear—at 75% freeness	66	94
Tear—at 50% freeness	61	86
Beating time—to 75% freeness	13 min.	24 min.
Beating time—to 50% freeness	25 min.	46 min.

* Required in making calcium hypochlorite solution.

in which optimum pH conditions were employed in the hypochlorite stage.

To obtain an 82 brightness, 9.15% available chlorine was required in the single-stage method as compared with a total of 4.85% chlorine in the two-stage method. The use of the latter method, therefore, resulted in a saving of 47% of the single-stage chlorine requirement. However, in accomplishing this saving, 0.8% of NaOH was required in the second stage.

The approximate amount of hydrated lime required in preparing the calcium hypochlorite solution for the single-stage bleach was 11.0%. In the two-stage method, only 2.2% was used, representing a saving of 80% of the single-stage requirement.

Comparative Pulp Quality

The two-stage bleached pulp showed the following superiority in quality over the single-stage bleached pulp:

(1) About 20% less fading.
(2) Higher alpha-cellulose content (87.3% as compared with only 81.8%).
(3) Lower ash content (0.32% as compared with 0.42%).
(4) About 25% higher maximum bursting strength.
(5) About 40% higher tearing resistance after beating.
(6) Greater resistance to beating as indicated by approximately an 85% longer beating time required to arrive at a given freeness.

The strength and beating characteristics of the two bleached pulps are shown in Fig. 9 along with those of the same pulp after chlorination but before bleaching. It will be noted that there is very little difference between the chlorinated pulp and the two-stage bleached pulp. This fact, together with the fact that there was little if any difference in the alpha cellulose content of the two pulps, leads to the conclusion that it is possible, by the proper use of the two-stage method, to bleach this type of pulp to an 82 brightness without material injury to the cellulose fiber. It is noteworthy that it was not necessary to employ an additional stage of purification, such as a mild alkaline extraction after chlorination, to accomplish this result.

Conclusions

A particular air-dry west coast sulphite pulp has been treated with 3.0% of chlorine gas at a pulp consistency of 4.0% and a temperature of 75° F. and then given a water wash. In bleaching this chlorinated pulp with calcium hypochlorite solution to a constant brightness of 82 employing a pulp consistency of 6% and a temperature of 105° F., it was found that:

(1) When calcium hypochlorite alone was used, the initial pH was 7.75 and the final pH was 6.0.

When NaOH was added to the pulp before the hypochlorite solution in amounts varying from 0.4 to 1.5%, the initial pH ranged from 8.4 to 11.0, while the final pH ranged from 6.45 to 10.1.

When hydrochloric acid was added to the pulp before the hypochlorite solution in amounts varying from 0.25 to 0.5%, the initial pH was 7.2 to 7.0 and the final pH was in the range of 5.0 to 3.3, respectively.

(2) In all instances phenolphthalein indicator gave a pink color reaction whenever the pH value was above approximately 6.8.

(3) When hypochlorite alone was added to the pulp, the second stage chlorine requirement was 2.4%. As the final pH of bleaching was increased by the use of caustic soda, the chlorine requirement dropped to a minimum of 1.75% at a final pH of about 8.5. As the final pH was further increased, the chlorine requirement increased somewhat. When hydrochloric acid was used, the requirement dropped to a figure of 2.2% at a final pH of about 4.8. Further acidification resulted in a rather sharp increase in the amount of available chlorine required.

(4) When hypochlorite alone was used, the bleaching time was 4.3 hours. Addition of alkali resulted in a sharp decrease in bleaching time to a minimum of 2.15 hours at a final pH of about 7.5. As the final pH was further increased the bleaching time lengthened, at first gradually and then quite sharply as the final pH rose above 9.0. When acid was employed, the time dropped to 3.7 hours at a final pH of 4.8 and then increased gradually as the final pH decreased further.

(5) The pH of bleaching had little effect on the bursting strength of the pulp. There was a tendency toward slightly lower values at a final pH of about 6.0 and again as the lowest pH values were approached. The use of sufficient alkali to give a final pH between 8.0 and 9.0 resulted in an appreciable improvement (about 10% at 50% freeness) in tearing resistance. At still higher pH values, the strength appeared to gradually drop off again. Lowering the final pH to about 5.0 resulted in a small improvement in tear. As the final pH dropped below 5.0, there was a rather sharp drop in tearing resistance. When alkali was added to give a final pH of about 8.0, the beating time was 33% longer than when no alkali or acid was used. As the final pH values approached 10 the beating time fell off somewhat. At a final pH of 5.0 the beating time was slightly higher than at 6.0. Below a final pH of 5.0 the beating time gradually decreased again.

(6) Bleaching with hypochlorite solution alone gave an alpha-cellulose content of 84.0%. By utilizing caustic soda to give a final pH of 7.5, the alpha-cellulose content increased sharply to a value of 87.3%. This figure remained practically constant as the final pH was raised to as high as 10.1. Between a final pH of 4.5 and 5.75, the alpha content remained practically constant at 83.5%. As the final pH fell below 4.5, the alpha dropped quite sharply to a value of about 81.0% at a final pH of 3.3.

(7) Bleaching with hypochlorite alone, gave an ash content of 0.18%. This figure dropped only slightly when acid was used to give final pH values as low as 3.3. The use of caustic soda increased the ash content to a figure of about 0.4% at a final pH of 8.5. The ash then remained constant as the final pH was increased to 10.1.

(8) When the pulp was bleached with hypochlorite alone, the bleached pulp dropped 6.5 points in brightness when subjected to the fading test. As the final pH of bleaching was increased, the pulp faded less. At a final pH of 7.75, the fading amounted to only 4.0 points. Increasing the final pH further to 10.1 only reduced the fading to 3.4 points. When a low final pH was obtained by the use of acid, the fading increased somewhat to a maximum of 7.3 points at a final pH of 4.5. Further acidification somewhat improved the stability of color.

(9) When the pH during bleaching was held constant at values ranging from 5.5 to 9.25, the results were similar to those obtained when high initial pH values were used. However, when a constant pH was used, it was observed that (a) the minimum chlorine requirement was about 10% higher; (b) the minimum bleaching time was about 10% longer; (c) there was a more pronounced loss in strength properties in the low pH range, also lower tear and shorter beating time under optimum pH conditions; (d) there was a more pronounced drop in alpha cellulose content in the low pH range, also lower alpha content under optimum pH conditions; (e) the ash was less but the fading more under pH conditions giving the shortest bleaching time and strongest pulp. In general, in the two-stage treatment of this pulp, the use of a high initial pH was productive of better results than the use of a constant pH of bleaching.

(10) The abrupt decrease in bleaching efficiency which was observed in the region of 6.5 pH may in some way be related to the increased tendency of hypochlorite solutions to form chlorate at this same pH.

(11) Compared with regular single-stage bleaching in which hypochlorite alone was used, two-stage bleaching of this particular pulp employing optimum pH conditions in the hypochlorite stage resulted in the following benefits: (a) a 47% saving in chlorine; (b) an 80% saving in hydrated lime; (c) about 20% less fading; (d) an alpha content of 87.3% as compared with 81.8%; (e) a lower ash content; (f) a 25% higher maximum bursting strength; (g) a 40% higher tearing resistance after beating. The two-stage bleached pulp required approximately an 85% longer beating time to arrive at a given freeness. The bleaching time in the hypochlorite stage of the two-stage treatment was 2.15 hours as compared with 3.63 hours in the single-stage method using hypochlorite solution alone.

(12) The pulp bleached by the two-stage method under optimum pH conditions did not show any signs of degradation either in strength characteristics or in alpha-cellulose content when compared with the chlorinated unbleached pulp. It is of interest to note that this result was accomplished without the use of an additional stage of purification, such as an alkaline extraction after chlorination.

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Some Observations on the Problem of Iron in Bleaching Wood Pulp*

By E. L. Keller[1] and F. A. Simmonds[2]

Abstract

In bleaching, both the chlorination and hypochlorite stages, particularly the former, tend to remove iron from pulp, but if iron-containing water is used for washing, the pulp will reabsorb iron. Indications are, however, that iron contents up to 0.15 p.p.m. are tolerable in the washing water. In general, iron content of bleached pulp has an influence on pulp color.

It is commonly recognized that the presence of even small amounts of iron in the process water used in bleaching will impair the brightness of the bleached pulp. Also, adverse effects on pulp strength and chemical properties, increased bleach demand and increased rate of bleach consumption have been attributed to the presence of iron in the process water. There are several instances in the literature wherein the maximum tolerable concentration of iron is set at 0.1 or 0.15 p.p.m. There are, however, no attendant accurate definitions of the corresponding loss in pulp quality when these amounts are exceeded.

The effect of the presence of iron in paper in accelerating its deterioration has been determined quantitatively by Richter *(10)* who found adsorbed iron salts to be definite catalysts of folding strength degradation. In the field of rayon pulps, Essenlen and Gurley's *(4)* specifications indicate that the rayon industry prefers not over 7 p.p.m. of iron in such pulps.

The present report deals with the adsorption of iron from aqueous solution, and the effect of iron in the process water that is used in bleaching on the color of the bleached pulp.

Iron in Process Water

Iron occurs in natural waters chiefly as ferrous bicarbonate. Less common forms are ferrous carbonate, ferrous and ferric sulphate, ferric gallotannate, and other soluble or insoluble organic combinations. The solubility of ferric iron in alkaline waters is quite low (0.1 p.p.m. at pH 8.5). Hence most of the iron in a freshly-filtered alkaline water probably would be in the ferrous form when first used in pulp and papermaking operations.

The ferrous ion, however, oxidizes very readily. In fact, one established means of lowering the iron content of water consists of a simple spraying to get the water in contact with air, followed by filtration. It thus appears that an unpredictable amount of the ferrous iron in fresh mill waters may be oxidized to the less soluble form, either accelerated by mechanical action such as the whipping of the beater roll; chemically, as in the oxidizing bleaching processes; or simply by exposure of the surface to air. Öman *(8)* has stated that paper will take up iron from ferric compounds but little from the ferrous forms.

TABLE I.—STABILITY OF DISSOLVED IRON IN MADISON CITY WATER DURING STORAGE AT 4° C.

Bottle	Level of water	Elapsed time since filling	Iron content, p.p.m.
1	Full	35 minutes	0.21
			.21
2	Full	23 hours	.21
			.19
3	Full	46 hours	.20
			.20
1	¾ full	5 days	.15
			.19
2	¾ full	6 days	.14
			.19
1	½ full	12 days	.09
1	¾ full, but contents thoroughly agitated prior to sampling	12 days	.53
3	¾ full	12 days	.06
3	¾ full, but contents thoroughly agitated prior to sampling	12 days	.32

It is evident that the iron content of a pulp may increase not only through pure adsorption, but also by filtering out iron which has been precipitated as a result of oxidation. Such loosely-held iron is, of course, more susceptible to removal by turbulent washing than iron which has been truly adsorbed.

An experiment was made to obtain a quantitative indication of the oxidation effect on the dissolved iron in Madison city well water. Three bottles were filled completely with water directly from Well 6 for the stability test and these samples were stored at a temperature of approximately 4° C. The iron content of each was then determined according to the schedule shown in Table I. It is apparent that when air was excluded from contact with this water there was no change in the amount of iron in solution for at least 2 days. When the water was allowed to come in contact with the air, an appreciable decrease in dissolved iron occurred within 5 days and at the end of 12 days about 60% had precipitated. The latter point is established by the fact that the iron content values after agitation of the water at the end of the 12-day period were much higher than before agitation.

It should be noted that the decrease in the iron content of the supernatant water may not be a true measure of the rate of oxidation of the dissolved iron, because the rate of settling of the oxidized material is unknown.

Adsorption of Iron from Solution

The concept of an exchange mechanism in the adsorption of cations by cellulosic materials was, according to McLean and Wooten *(6)*, first advanced by Michaelis and Rona in 1919 *(7)*. It has since been confirmed by several investigators that the cation-holding constituents behave in a manner similar to that of a zeolite. For example, iron may be taken up by pulps from aqueous solutions of its salts with

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[1] Member TAPPI, Junior Chemist, Forest Products Laboratory,[3] Forest Service, U. S. Department of Agriculture.

[2] Member TAPPI, Associate Chemist, Forest Products Laboratory,[3] Forest Service, U. S. Department of Agriculture.

[3] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

the simultaneous release of an equivalent amount of other cation, such as calcium or magnesium, from the pulp. Treatment of the pulp with acid to lower the ash content replaces the metallic cations with hydrogen.

McLean and Wooten *(6)* concluded that the ash constituents exist as metal-organic compounds associated with the impurities, which include beta- and gamma-cellulose, uronic acids, oxycellulose, and reactive groups associated with the lignin. The generalization is made that the capacity for exchange adsorption decreases as the alpha-cellulose content of a pulp approaches 100%.

Adsorption as Related to Concentration

Preliminary to studies with natural iron-containing waters, various adsorption and bleaching data were obtained in which iron-containing suspension obtain and adsorption waters were made up with combinations of ferrous ammonium sulphate and distilled water and ferrous ammonium sulphate and Birmated water[4]. The purpose was to insure exact control of the iron concentrate and to provide a wider range of the latter than would be possible with Madison city well water.

The adsorption data reported in Table II and Fig. 1 were obtained by soaking portions of a commercially bleached sulphite pulp (P-1148) in water solutions containing varying amounts of the ferrous ion and subsequently analyzing the pulp for iron content. This pulp was received in wet-lap form and contained 87% alpha-cellulose, 0.2% ash, and 6 p.p.m. of iron. The color of the pulp in parts Ives was: red, 89; green, 89; blue, 89.

For adsorption, 15-gram samples (moisture-free equivalent) were each alternately soaked and washed in a Büchner funnel with 5 liters of distilled water over a period of approximately 75 minutes to remove residues and impurities soluble under these conditions. The final mat was broken up in a quantity of water sufficient to give a total of 3 liters of water after the addition of the prescribed volume of iron solution. Enough ferrous ion was added from a freshly-prepared solution of ferrous ammonium sulphate to give concentrations of 0.06, 0.17, 0.33, or 0.67 mg. of iron per liter of water, and the suspension stirred vigorously to insure immediate and uniform distribution. These mixtures were allowed to stand for 18 hours at 20°-25° C.

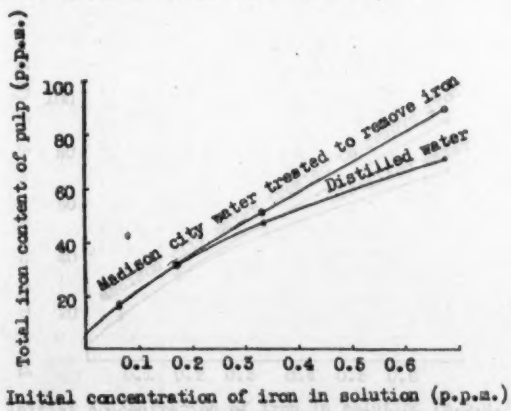

FIG. 1

Adsorption of Iron by Bleached Sulphite Pulp. P-1148

[4] Madison city well water which had been passed through a filter bed of Burgess iron removal mineral.

TABLE II.—ADSORPTION OF IRON FROM AQUEOUS SOLUTION BY A BLEACHED SULPHITE PULP (P-1148)

Initial concentration of iron in the water, p.p.m.	Final iron content of the pulp, p.p.m.	Amount of the available iron adsorbed by the pulp, %	Final concentration of iron in the water,[1] p.p.m.
	Distilled Water		
0.06	17	90	0.006
.17	32	78	.038
.33	47	61	.130
.67	71	49	.340
	Tap Water Treated for Iron Removal[2]		
.06	16	85	.009
.17	32	78	.038
.33	51	67	.110
.67	90	63	.250

[1] Calculated.
[2] By means of the Burgess iron removal mineral.

The suspension was then poured into a sheet-machine, the pulp mat pressed between blotters at 100 p.s.i. and allowed to dry in the air between the blotters. Convenient amounts of the dry sheets were washed in quartz crucibles, the ash taken up in warm dilute hydrochloric acid, evaporated to dryness, and analyzed by the standard colorimetric KSCN method for the determination of iron in water *(1)*.

Two parallel series of experiments were made. In one series distilled water was used throughout. In the second series, the quite alkaline (310 p.p.m. calculated as $CaCO_3$) Madison city well water was used after passage through a Birm unit.

Reference to Fig. 1 reveals that an increase in the initial concentration of iron in the suspension over the concentration range used resulted in an increase in the amount of iron taken up by the bleached sulphite pulp. This was true for both waters used. The curves, which are similar to adsorption isotherms, indicate that the kind of suspension water had no effect on the amount of iron adsorbed until the initial iron concentration in solution exceeded 0.2 p.p.m. Over the concentration range from 0.2 to 0.7 p.p.m., however, more iron was taken up and at an increasing rate by the pulp from the treated water suspensions than from the distilled water suspensions.

Two factors are recognized as possible causes of this difference. One is the difference in hydrogen ion concentration at which adsorption occurred in the two suspension waters. The distilled water suspension had a pH value of about 6, whereas the treated water suspensions had a pH value of about 8.5, both values having been determined colorometrically.

The presence of large amounts of other electrolytes in the treated water may have been the second factor. Kruyt *(5)* has pointed out that, in some cases, when two electrolytes are present, each is more strongly adsorbed than when either is present alone.

Washing of Iron-containing Pulps

Given a pulp containing adsorbed iron the question arises if any of this iron can be removed by a thorough washing with iron-free water. To obtain information on this question, washing experiments using iron-free water were made with two pulps. One of the pulps was in wet-lap form from the laboratory wet machine and thus had been subjected to a considerable amount of washing with water that contained only about 0.06 p.p.m. of iron. This pulp was a commercial unbleached kraft pulp containing 33 p.p.m. of iron.

From each of these pulps four samples were taken, each containing the equivalent of 15 grams of moisture-free fiber.. Each sample was washed continu-

ously in a Büchner funnel with 1 liter of distilled water, then allowed to soak ½ hour in a liter of distilled water, again washed continuously with a liter of the water, soaked as before, and then given a final continuous wash with a liter of the water.

The iron contents of the samples were not lowered by this washing treatment. It is, therefore, indicated that the iron present in the pulps was held by adsorption forces sufficient to resist removal by even extensive washing with iron-free water.

The amount of iron which can be removed from a pulp by washing may vary with different pulps and different conditions of washing. Czapla *(2)* found that iron could be washed readily from straw and sulphite pulps; but not from soda and mechanical pulps. Du Rietz *(3)* found that cations of high valence are more difficult to wash out than those of lower valence. In dealing with iron, which may be present in either the ferrous or the ferric state, this finding may be significant.

Effect of Hydrogen Ion Concentration on Adsorption

Hydrogen ion concentration, as previously mentioned, was probably one factor accounting for the difference in the amount of iron adsorbed from solution by a pulp suspended in, respectively, distilled and treated waters. The data which are deemed indicative of this are in Table III and Fig. 2 and 3, those in Fig. 2 having been obtained using the same commercially-bleached sulphite pulp used in the water comparison.

The procedure in this experiment was to adjust the hydrogen ion concentration of a series of suspensions in treated water, each containing 2.0 mg. of added ferrous iron in the same volume of solution. The desired pH was obtained by the addition of either hydrochloric acid or sodium carbonate prior to the addition of the pulp. A glass-electrode pH meter was used to measure hydrogen iron concentration. Adsorption was allowed to proceed for 17 hours after which the suspensions were filtered on a Büchner funnel, drained with suction, but not washed. The pulps were then analyzed for iron content.

The curves in Fig. 2 and 3 show a marked decrease in the amount of iron adsorbed with increasing acidity of the systems, under the experimental conditions that obtained. In the pH range where alkali was added,

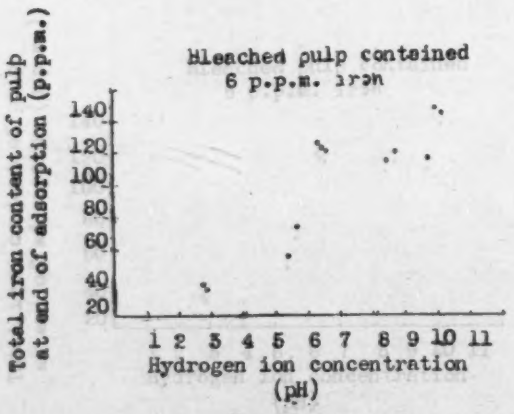

Fig. 2

Effect of H-Ion Concentration on Iron Adsorption by a Bleached Spruce Sulphite Pulp. P-1148

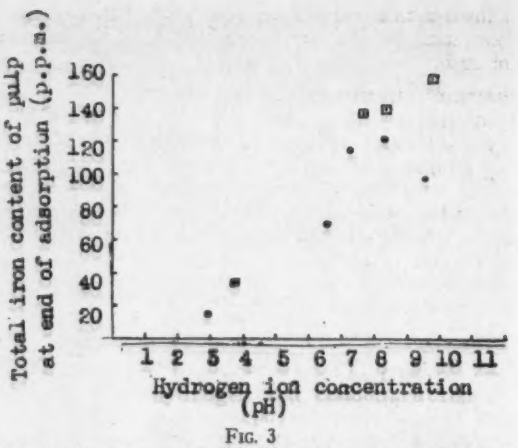

Fig. 3

Effect of H-Ion Concentration on Iron Adsorption by Unbleached Lowland White Fir Sulphite Pulp. (Dig. 3679-I.) ⊞—Original Pulp, Contained 30 p.p.m. Prior to Adsorption. O—HCl—Extracted Pulp, Contained 3.4 p.p.m. Iron Prior to Adsorption.

iron was probably taken up as the hydroxide as well as adsorbed in the ionic form. Other investigators have found that the precipitation of hydrated ferrous oxide by alkali begins at pH 5.5.

An unbleached lowland white fir sulphite pulp (Dig. 3679-I) was used for the experiment shown in Fig. 3. This pulp was used in two forms. In the one case the pulp was extracted with 1:1 hydrochloric acid for 15 minutes and then washed until free from chlorides. This treatment reduced the original iron content from 30 to 3.4 p.p.m. In the second case the pulp was used in its original form.

Again, the amount of iron taken up increased as the acidity of the system decreased. Calculation of the amounts of iron taken up by the two pulps did not show a consistent trend of difference.

The probability of hydrolyzing some portions of the pulp by such a strong acid treatment as was used in securing the data shown in Fig. 3 must be recognized. Percival, Cuthbertson, and Hibbert *(9)* found that acid extraction lowered the alpha-cellulose content and reduced the adsorptive capacity of pulps high in alpha-cellulose. Their pulp was placed in an alum solution, removed, washed, soaked in a 25% hydrochloric acid solution for 2 hours, washed, and again placed in an alum solution. The pulp took up only

TABLE III.—INFLUENCE OF H ION CONCENTRATION ON IRON ADSORPTION BY SULPHITE PULPS

Final H ion concentration of suspension,[1] pH	Total iron content of pulp, p.p.m.	Reagent used to control H ion concentration
Bleached Spruce Sulphite Pulp (P-1148) Contained 6 p.p.m. Fe Prior to Adsorption		
2.74	19	5 cc. 3N HCl
2.81	16	5 cc. 3N HCl
5.38	35	4 cc. 3N HCl
5.67	54	4 cc. 3N HCl
6.35	105	3 cc. 3N HCl
6.46	102	3 cc. 3N HCl
6.58	100	3 cc. 3N HCl
8.43	94	.....
8.68	100	.....
9.73	96	1 g. Na_2CO_3
9.98	127	1 g. Na_2CO_3
10.12	124	1 g. Na_2CO_3
Lowland White Fir Sulphite (Dig. 3679-I) Contained 30 p.p.m. Fe Prior to Adsorption		
3.78	34	5 cc. 3N HCl
7.65	137	1 cc. 3N HCl
8.36	140	.....
9.78	158	1 g. Na_2CO_3
HCl-Extracted Lowland White Fir Sulphite (Dig. 3679-I) Contained 3.4 p.p.m. Fe Prior to Adsorption		
2.96	15	6.5 cc. 3N HCl
6.52	69	5 cc. 3N HCl
7.26	114	3 cc.
8.36	121	.....
9.56	97	1 g. Na_2CO_3

[1] Birmated water was used as the suspension medium to which was added, in each case, 2.0 mg. of ferrous iron, thus yielding a concentration of 0.67 p.p.m. of iron.

a third as much aluminum as it did in the first adsorption; and on the fourth adsorption cycle only one-seventh.

Rate of Adsorption

As might be expected the rate of adsorption of iron from solution was rapid, as illustrated by the following tabulation of typical data:

Adsorption period, hours	Iron content of pulp, p.p.m.
0	6
1/60	90
½	94
4	94
18	125

Iron Contents of Typical Pulps and an Indicated Source of Iron

Various typical pulps were analyzed to find the range of iron content likely to be encountered. They comprised both commercial pulps and experimental pulps made at the Forest Products Laboratory. Table IV presents data on the iron contents of the unbleached pulps and of the wood chips from which four of the pulps were prepared. The data show that although the wood chips contained only 6 to 7 p.p.m. of iron, the pulps made from them contained from 30 to 200 p.p.m. of iron. Assuming a pulp yield of 50% and also assuming that the pulp retained all of the iron originally present in the wood, the actual amounts found in the pulps would still be from 2 to 4 times greater than thus accounted for. The adsorption data in Fig. 1 indicate that the source of this large increase can scarcely be attributed solely to adsorption from the water used in washing and screening, which contained only about 0.06 p.p.m. of iron. The conclusion then is that the digestion process is one of the main sources of iron contamination.

Of the pulps made at the Forest Products Laboratory, the sulphite pulps appear to be consistently lower in iron than the sulphate pulps. The sulphite digester has a stainless iron alloy lining whereas the sulphate digester is made of carbon steel. The loblolly pine sulphate pulps prepared from the same wood shipment and numbered 11 and 12 in Table IV were cooked,

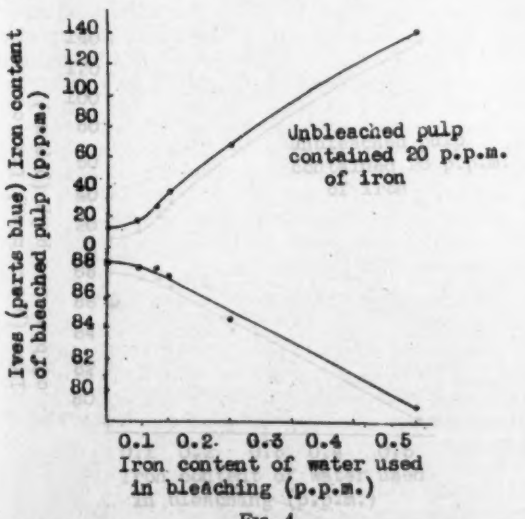

FIG. 4

Relation of Color and Iron Content of Bleached Sulphite Pulp P-1213 to Iron Content of The Water Used in Bleaching

TABLE IV.—IRON CONTENTS OF TYPICAL UNBLEACHED PULPS

Tabular number		Iron content, p.p.m.
	Commercial Pulps	
1	Spruce sulphite (P-984)	13
2	Spruce sulphite (P-1213)	20
3	Eastern hemlock sulphite (P-1168)	60
4	Eastern hemlock sulphite (P-1212)	120
5	Southern pine sulphate (P-1231)	33
	Laboratory Pulps	
6	Lowland white fir sulphite [1] (3679-I)	30
7	Lowland white fir sulphite (3687-I)	31
8	White spruce sulphite (3664-I)	76
9	Loblolly pine sulphite (3636-37-38-I)	40
10	Longleaf pine sulphate (656-67-58)	112
11	Loblolly pine sulphite,[2,4] (2483)	200
12	Loblolly pine sulphate[3,4] (2484)	77
13	Loblolly pine sulphate [4] (412-13-14)	95

[1] The iron content of the chips prior to digestion was 7 p.p.m.
[2] Cooked in a steel digester.
[3] Cooked in a digester lined with stainless iron alloy.
[4] The iron content of the chips prior to digestion was 6 p.p.m.

respectively, in the sulphate and sulphite digesters with equal amounts of liquor taken from the same source. Since the iron content of the former was 200 p.p.m. and that of the latter was 77 p.p.m., it is apparent that the difference in the iron contents observed was due to the difference in the resistance of the digester linings.

As an indication of the amount of iron in bleached pulps, it will be recalled that the bleached spruce sulphite pulp, P-1148, used in the adsorption experiments had an iron content of only 6 p.p.m.

Iron Concentration Series Using Ferrous Ammonium Sulphate

A series of bleaches was made using ferrous ammonium sulphate as the source of iron in the process water in order to obtain a greater concentration range (0 to 0.5 p.p.m. of iron) than possible with the Madison city well water.

The equivalent of 20 grams of moisture-free pulp was bleached at 2% consistency in three stages. The first stage comprised direct chlorination with 5.9% chlorine based on the weight of pulp and the addition of enough sodium hydroxide after a reaction period of 5 minutes to raise the pH value from about 1.6 to 8.5. After exhaustion of the bleach, the pulp was washed in a Büchner funnel with 5 liters of the respective iron-containing process waters. In the second stage 0.5% chlorine was added in the form of calcium hypochlorite. At the end of this stage the pulp was washed as before. The third stage was a "flash" chlorination with 0.05% chlorine after which the pulp was washed as before. The bleached pulp was made into test sheets using the prepared process water for dilution and the sheets dried in the air between blotters.

The iron contents and colors of the sheets are presented in Table V and illustrated in Fig. 4. Until the concentration of the iron in the process water was

TABLE V.—EFFECT OF IRON IN THE PROCESS WATER USED IN BLEACHING UPON THE COLOR AND IRON CONTENT OF A COMMERCIAL SPRUCE SULPHITE PULP (P-1213)

Concentration of iron in—		Color of the bleached pulp (Parts Ives)			
Water used, p.p.m.	Bleached pulp,[1] p.p.m.	Red	Green	Blue	Average parts blue
0.00	13	93	92	88.5	88.3
.00	12	92	92	88.0	
.05	18	91	90½	87.5	87.8
.05	18	91	90½	88.0	
.08	25	90½	90	87.5	87.8
.08	27	91	90½	88.0	
.10	38	90½	90	87.0	87.3
.10	36	91	90	87.5	
.20	70	90½	89½	85.0	84.5
.20	65	90½	89	84.0	
.50	140	91½	86½	79.0	79.0

[1] Iron content of the unbleached pulp was 20 p.p.m.

a little over 0.05 p.p.m. the bleaching procedure actually reduced the iron content of the pulp. At a concentration of 0.08 p.p.m. of iron, the bleached pulp contained 6 p.p.m. more iron than did the original pulp.

Added and Naturally Occurring Iron in Process Waters

The question inevitably arises whether phenomena observed using process waters prepared by adding iron in the form of an inorganic salt parallel those using waters with iron in its naturally occurring forms. The answer is complicated by the many forms in which the natural iron may be present, examples of which were cited early in this report. Investigation of the absorption of all forms of natural iron is impractical due to the minute quantities involved, the extreme dilution, susceptibility to oxidation and consequent precipitation, and the action of bleaching reagents, all of which lead to difficulties in the identification and control of the form. The locating and successful transportation of a suitable assortment of waters of about the same chemical composition, aside from iron, is in itself a major problem. Fortunately, one of the deep wells of the local municipal water supply was delivering water containing 0.28 p.p.m. natural iron, and advantage was taken of this to make several experiments using:

1. City water with the iron removed by passage through the Birm unit.
2. City water with natural iron removed, but with 0.2 p.p.m. iron added as ferrous ammonium sulphate.
3. City water direct from the Dayton Street well, containing 0.28 p.p.m. of natural iron.

A commercial spruce sulphite (P-1468) was bleached, using the same general technique as previously described. The actual bleaching conditions comprised a first stage treatment with 3.6% by weight of elemental chlorine, a second stage extraction with 1% by weight of sodium hydroxide at a temperature of 50° C., and a third stage bleach with 0.4% chlorine as calcium hypochlorite. The results in terms of iron content and color of bleached pulp are presented in Table VI. Unfortunately, the iron content of the water made up by the addition of ferrous ammonium sulphate was 0.08 p.p.m. less than that with the naturally occurring iron.

TABLE VI.—COMPARISON OF PROCESS WATERS CONTAINING "NATURAL" AND "ADDED" IRON

Description of process water used in bleaching and washing	Iron content,[1] p.p.m.	Color[1] (Parts Ives) Red	Green	Blue
City water from which all iron had been removed	11	90.3	89.8	87.6
Iron-free city water to which 0.2 p.p.m. iron had been added as ferrous ammonium sulphate	65	90.1	89.1	86.3
City water from Dayton Street well, containing 0.28 p.p.m. "natural" iron	68	90.3	88.5	86.2

[1] Averages of four bleaches for each water.

It is indicated, however, since the effect was the same with both waters that conclusions as to tolerable iron content in the process for a given pulp may possibly be safely based on determinations made using process water to which iron has been added as ferrous ammonium sulphate. A "given pulp" is specified because the results in Table V, obtained with a different pulp indicate that the iron content-color relation varies somewhat depending on the pulp.

It should not be inferred that the comparative effect of added and natural iron is thought not to vary from one natural water to another. It is obvious that all of the data in the entire report represent only a small fraction of the amount of work required by a comprehensive study of the subject and, therefore, all indicated conclusions must be qualified by the recognition that some variation is likely to be encountered from case to case. It is true, however, that a sufficient amount of quantitative data are now available as a take-off point for a mill to determine with a comparatively small amount of work the iron tolerance for the pulps and process water with which they deal.

Adsorption of Iron from Waters with Natural and Added Iron

Preliminary experiments were made to learn whether the comparison of natural and added iron could be more quickly made by merely soaking bleached pulp in the iron-containing water for a period instead of carrying through multistage bleaches using wash waters of known iron content. A quantity of the pulp P-1468 was bleached using distilled water throughout, and divided into three parts. Color and iron were determined on one portion and the other two were soaked respectively in water from the Dayton Street well containing 0.28 p.p.m. natural iron, and similar water containing 0.28 p.p.m. iron added as ferrous ammonium sulphate. Similar experiments were made with the unbleached pulp.

TABLE VII.—ADSORPTION OF IRON FROM WATERS WITH NATURAL AND ADDED IRON

	Iron content,[1] p.p.m.	Color[2] (Parts Ives) Red	Green	Blue
Pulp[2] Bleached with Distilled Water				
Pulp before soaking	11	90.2	89.2	87.8
Pulp after soaking in water containing 0.28 p.p.m. natural iron	37	91.0	89.1	87.2
Pulp after soaking in water containing 0.28 p.p.m. added iron	59	89.4	87.3	85.0
Unbleached Pulp[2]				
Pulp before soaking	32	73.0	64.3	61.0
Pulp after soaking in water containing 0.28 p.p.m. natural iron	39	72.1	64.0	59.7
Pulp after soaking in water containing 0.28 p.p.m. added iron	56	69.9	62.2	58.7

[1] Experiments were run in triplicate in the case of the natural iron; duplicate with the added iron.
[2] Commercial spruce sulphite, P-1468.

As shown by the results in Table VII, about 50% more iron was taken up from the water containing the added ferrous salt. In the bleaching experiments the "natural" water contained about 40% more iron than did the "synthetic" water and the pulps adsorbed the same amount of iron from each. The two series of experiments thus roughly agree quantitatively. However, insofar as color is concerned, the relative decrease is not proportionate to the amount of iron adsorbed in the bleaching and in the soaking tests.

It is thus indicated that actual bleaching experimentation is the procedure to be recommended for determining iron tolerance.

Variation of Iron Content During Stage Bleaching

It appeared desirable to determine iron content of the pulp used in the series for sulphite pulp P-1213 after each step in the multistage bleaching, using the process water containing 0.2 p.p.m. of iron. The results obtained are recorded in Table VIII.

It was previously pointed out, Figs. 2 and 3, that (1) in the acid range an increase in the acidity of a pulp suspension containing iron tends to decrease the amount of iron a pulp will adsorb from solution and (2) extraction of an iron-containing pulp with hydro-

TABLE VIII—VARIATION IN THE IRON CONTENT OF SULPHITE PULP P-1213 DURING BLEACHING

Point in the bleaching process at which analysis was made	H-ion concentration pH	Iron content of pulp I p.p.m.	II p.p.m.	III p.p.m.	Average p.p.m.
Original pulp, unbleached	..	..	..	..	20
Stage 1, 5 minutes after addition of 5.85% chlorine	1.7	12	12	..	12
Stage 1, at exhaustion after addition of NaOH, before washing	7.0	11	14	..	13
Stage 1, after washing with iron-containing water [1]	8.4	36	45	36	39
Stage 2, after exhaustion of 0.5% chlorine as $Ca(OCl)_2$	7.8	18	20	..	19
Stage 2, after washing with iron-containing water	8.4	66	57	62	62
Stage 3, 20 minutes after addition of 0.05% chlorine	7.9	38	40	..	39
After final washing and making up into sheets with iron-containing water	8.4	..	..	..	67

[1] Birmated water to which had been added 0.2 p.p.m. of iron as ferrous ammonium sulphate.

chloric acid will decrease the iron content.

The pulp used in the bleaching and washing experiment described in Table VIII contained, originally, 20 p.p.m. of iron. At the end of the chlorination stage, but before washing, the iron content was reduced to 12 p.p.m. This result is in agreement with the findings cited in the foregoing paragraph. When the pulp from this stage was washed with water containing 0.2 p.p.m. of iron in the form of ferrous ammonium sulphate, the iron content of the washed pulp was 39 p.p.m. which is twice the amount present in the unbleached pulp.

After the calcium hypochlorite stage, but before washing, the iron content was reduced to the amount present in the original pulp. The subsequent washing treatment brought the iron content up again and to a new high of 62 p.p.m. The third stage "flash" chlorination with 0.05% chlorine in which the pH value was the same as that obtaining in the previous hypochlorite stage removed 22 p.p.m. of iron but the residual was still as high as that of the washed pulp after the first stage chlorination.

After the final washing at the end of the "flash" chlorination stage and the forming of the washed pulp into test sheets using the iron-containing water in the sheet machine, the test sheets contained 67 p.p.m. of iron. This iron content checks with that of the bleach in Table IX in which a 0.2 p.p.m. process water was used.

The results also show the wash water to be the chief source of iron contamination.

Comparison of Three Process Waters

Several unbleached samples of a monosulphite pulp S-199 were washed with different process waters and then bleached, using as process waters the corresponding ones used for the original washing. The iron content of the washed but unbleached pulps varied considerably. These pulps, with one exception, were each bleached by both a single-stage hypochlorite and a two-stage chlorination process. The details of the waters used and the color and iron contents of the bleached pulps are presented in Table IX. The hard tap water contained more than the normal amount of iron when these experiments were made.

These limited data indicate that when the iron content of the unbleached pulp is high a chlorination bleach tends to remove more iron than a hypochlorite bleach. Both processes, however, remove large amounts of iron. It is also indicated that the hard tap water from which the iron was removed is as good a process water as distilled. Instances have been observed where the use of iron-free hard tap water resulted in a slightly better color than when distilled water was used.

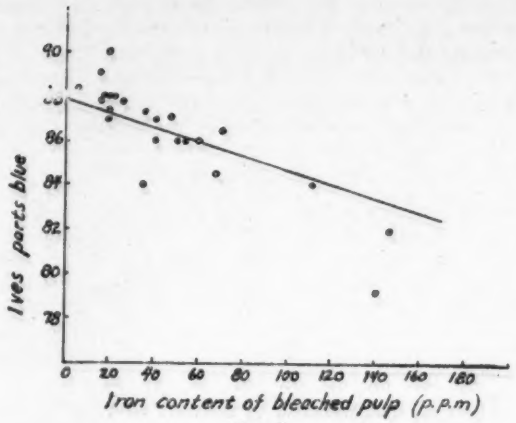

Fig. 5

Dependence of the Color of Bleached Pulp on the Iron Content

Dependence of the Color of Bleached Pulps on Iron Content

All of the foregoing data dealing with the color and iron content of bleached pulps were plotted in Fig. 5 with parts blue as the dependent variable. In the sources of these data are variables such as species, digestion and bleaching process, and the amount of chlorine consumed. Nevertheless, there is an apparent general, although not precise, dependence of color on iron content.

As indicated degrees of dependence was obtained when the regression coefficient of the calculated re-

TABLE IX.—COMPARISON OF THREE PROCESS WATERS

Key	Water used in washing unbleached pulp free of cooking liquor [1]	Iron content of pulp before bleaching, p.p.m.	Water used in bleaching and washing	Color (Parts Ives) Red	Green	Blue	Iron content I	II	Average
							p.p.m.		
			Bleached by a Single-stage Hypochlorite Process						
SP	Hard tap water	186	Hard tap water	87	86	84	40	30	35
			Distilled water	87	86	87	15	24	20
TWP	Hard tap water	824	Hard tap water	86	84	82	140	146	143
			Distilled water	86	86	86	53	49	51
BWP	Birmated hard tap water	67	Birmated water	88	87	86	40	..	40
			Distilled water	88	87	87	40	42	41
DWP	Distilled water	68	Distilled water	89	89	88	18	..	18
			Distilled water	91	89	88	20	..	20
			Bleached by a Two-stage Chlorine-hypochlorite Process						
TWP	Hard tap water	824	Hard tap water	88	86	84	105	120	112
			Distilled water	88	88	86	51	54	53
BWP	Birmated hard tap water	67	Birmated water	90	89	90	18	20	19
			Distilled water	87	89	88	19	24	22
DWP	Distilled water	68	Distilled water	90	8	89	15	17	16
			Distilled water	89	8	90	16	21	19

[1] Sample SP was washed in a screen box; all others in a centrifuge.

gression curve in Fig. 5 was found to be significant at the 5% level. The associated standard error of estimate was 2.45.

No inference is intended, however, that color can be predicted satisfactorily from the iron content of a pulp, nor that it would be desirable to be able to do so.

Conclusions

Papermaking pulps were observed to adsorb iron from aqueous solution, the amount increasing with increasing iron concentration. For a given concentration of iron, the amount taken up increased with decreasing acidity of the suspension. At low pH values adjusted with hydrochloric acid, the original iron content of the pulp was decreased, a fact that might well be expected.

Prolonged washing of iron-containing pulps with iron-free water did not remove all of the iron. As a matter of fact, extraction of an unbleached sulphite pulp containing 30 p.p.m. of iron with a 1:1 solution of hydrochloric acid for 15 minutes left a residual iron content of 3.4 p.p.m.

The lining of the digester in which a pulp is cooked and the water used in washing a pulp were found to be important sources of iron contamination.

Both chlorination and hypochlorite bleaching, but particularly the first, tend to decrease the iron content of a pulp. As indicated above, however, this advantage may be lost if iron-containing water is used for interstage washing. The indications are that iron contents up to 0.15 p.p.m. in process waters are tolerable.

In general, the iron content of a bleached pulp has an influence on the pulp color.

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Chart For Speck Analysis*

By B. L. Browning[1] and John H. Graff[1]

Abstract

In this chart the specks most common in pulp and paper have been classified as to their source as raw material dirt (which is subdivided into specks from wood, rags, and materials added to the pulp), process dirt, and mill dirt.

Identification of these specks is determined by three distinct characteristics—physical properties, solubility tests, and chemical tests — making it possible to identify most of the specks occurring in pulp and paper and to determine the source of their origin.

Specks or dirt in pulp or paper can, as a general rule, be divided into three main groups:

1. Raw material dirt from the wood, rags, or other cellulosic products, or from materials added during the manufacturing operation.
2. Process dirt.
3. Mill dirt.

If an analysis is to be made of dirt specks in pulp, it is best to use the marked and dried laboratory handsheets previously employed for speck counting (Adrian and Graff, *Paper Trade J.* 111, no. 19:32-40 (Nov. 7, 1940)); the sheets are dipped, one at a time, in distilled water and placed on a large watch glass. The specks are then picked out with a platinum-iridium needle and placed on a microscope slide.

If the analysis is concerned with the specks in paper, in most cases the marked specks should be cut out with scissors, soaked in distilled water, and removed from the paper with the platinum-iridium needles. A low-powered dissecting microscope is advantageous for this purpose. In some cases analysis is best done without removal of the speck.

Most of the commonly occurring dirt specks, as a rule, can be identified by the use of a microscope at a magnification of 50 to 100 times, using transmitted light. A binocular microscope is very useful but not essential. After some experience it will be found that the specks can be identified by their physical properties or state, and by different solubility and chemical tests.

The accompanying chart shows the physical properties and some of the solubility tests for the most common specks. The solubility tests and the chemical tests are referred to by numbers, and are explained below. Only tests which may be applied directly and which do not involve chemical separations have been listed.

Solubility Tests

1. Dilute hydrochloric acid (3*N*) is a solvent for iron, rust, pipe scale, and alum. Alumina and gypsum specks dissolve when heated, and bleach scale and some button specks effervesce. Manganese dioxide specks dissolve in concentrated hydrochloric acid.

2. Eighty per cent sulphuric acid: Outer and inner bark, knotwood, and shives are only partly soluble, but swell and become brown with this reagent. Resin and pitch dissolve with a yellow-brown to brown color reaction; rosin size spots dissolve slowly with an orange-brown color reaction for plain rosin size and rosin-clay size spots; rosin-alum size spots assume a yellow color. The reagent is a solvent for fiber knots, slime, and iron. Starch, bleach scale, alumina spots, rust, and pipe scale dissolve better when heated.

3. Five per cent sodium hydroxide is a good solvent for resin, pitch, and glue. Casein dissolves slowly, and felt hairs swell when heated. However, 10% potassium hydroxide is a better reagent for felt hairs.

4. Alcohol is a solvent for some dye particles. Resin and pitch dissolve when heated, and oil and grease dissolve slightly.

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5. Water dissolves alum specks and some dye particles. Glue dissolves when heated.

6. Ten per cent nitric acid is a solvent for copper oxide and copper sulphite, and for lead specks when used hot. Concentrated nitric acid must be used for copper sulphide and is also better for metallic copper.

7. Benzene is a solvent for oil and grease; resin and pitch dissolve slowly, and unvulcanized rubber specks swell and dissolve only partly.

8. Alcohol containing 1% of concentrated hydrochloric acid is a good solvent for resin, pitch, and some dye particles, as well as for rosin size spots, although the solution of these spots may be slow in the case of mixtures.

9. Alcohol containing 1% of concentrated ammonium hydroxide is a solvent for some dyes.

10. Hydrofluoric acid is a solvent for silicate materials. It is usually necessary to warm the mixture, especially if the particles are fairly large, and solution may be somewhat slow. The reaction should be

CHART FOR SPECK ANALYSIS

	KINDS OF SPECKS	PHYSICAL PROPERTIES OR STATE								SOLUBILITY TEST					Chemical Test
		Color (By Reflected Light)	Color (By Transmitted Light)	Hardness	Friability	Structure	Smudging or Streak	Melting Properties or Odor	Fluorescence	Dilute HCl 3N 1	80% H_2SO_4 2	5% NaOH 3	Alcohol 4	Other Solubility Tests	
RAW MATERIAL DIRT FROM WOOD	Outer Bark	Black to Brown	Yellow to Brown	Soft	Crumbles	Scale & Fiber			Brown		Partly. Brown Color				2,3&6
	Inner Bark	Orange to Brown	Yellow to Brown	Soft		Fiber			Brown		Partly. Brown Color				2,3,5&6
	Knotwood	Yellow to Brown	Yellow to Brown	Hard	Splits	Fiber			Yellow		Partly. Brown Color				2,3,5&6
	Shives	Yellow to Colorless	Trans-lucent	Soft	Splits	Fiber			Brown to Light Blue		Partly. Brown Color				2,3&6
	Resin & Pitch	Reddish Brown, Amber to Colorless	Trans-lucent	Soft	Punky	Flaky		Melt. Odor	Green-Yellow		Dissolve. Color Yellow-Brown	Dissolve	Dissolve (Warm)	7&8	5
RAW MATERIAL DIRT FROM RAGS	Rubber Specks	Dark Red to Colorless	Dark to Light-Yellow or Red	Elastic				Odor	Yellow					7	
	Button Specks	Colored to Colorless	Opaque	Hard	Gritty	Scalelike				May Effervesce					
	Sealing Wax	Any Color	Opaque	Hard	Gritty			Melt. Odor							
RAW MATERIAL DIRT FROM MATERIALS ADDED	Alum Specks	Gray to Colorless	Dark		Shatter	Scalelike			Dark Violet	Dissolve (Warm)				5	11
	Rosin Size Spots	Amber to Colorless	Trans-parent	Soft	Shatter	Round		Odor	Light Yellow		Slowly. Yellow to Brown Color			8	5
	Starch Spots	Gray to Colorless	Trans-lucent	Soft	Punky				Light Blue		Dissolve (Warm)				1
	Glue Spots	Yellow to Colorless	Trans-lucent	Soft	Punky	Flaky		Odor	White			Dissolve		5	13
	Casein	Gray to Colorless	Some Trans-lucent	Soft	Punky	Flaky		Odor	White			Slowly			4
	Filler Spots	Gray to White	Opaque	Soft	Crumbles				Yellow						
	Dye Particles	Color of Dye		Soft									May Dissolve	5, 8 & 9	
PROCESS DIRT	Fiber Knots	Colored to Colorless	Trans-lucent	Soft		Fiber					Dissolve				
	Felt Hairs	Colored to Colorless	Dark	Soft		Fiber						Swells (Warm)			
	Asbestos Fibers	Gray to White	Translucent to Opaque	Hard	Splits	Fiber			Purple						14
	Rubber Specks	Dark Red to Colorless	Dark to Light Yellow or Red	Elastic				Odor	Yellow					7	
	Iron	Black to Silver Gray	Opaque	Hard						Dissolve (Rapidly)	Dissolve (Rapidly)				8, 9 & 10
	Rust	Black to Brown-Red	Opaque	Medium	Shatters or Crumbles	Scalelike or Granular	Brown			Dissolve	Dissolve (Warm)				9 & 10
	Scale from Mill Pipes	Gray to Brown-Red	Opaque	Medium	Shatters or Crumbles	Scalelike with Fibers				Dissolve	Dissolve (Warm)				9 & 10
	Copper Sulphide	Black	Opaque			Fore Structure	Black							6	7
	Copper Alloys	Metallic Luster	Opaque	Hard	Scalelike Chips or Fragments									6	8, 9 & 10
	Lead Specks	Gray	Opaque	Medium			Metallic							8	
	Graphite	Black and Shiny	Opaque	Soft	Greasy	Flaky	Gray to Black								15
	Bleach Scale, Lime or Concrete	Gray to Colorless	Opaque	Hard	Gritty	Scalelike			Yellow-Brown	Effervesce	Dissolve (Warm)				
	Sand, Silica, Glass or Tile	Colored to Colorless	Opaque to Translucent	Hard	Gritty				Purple					10	
	Alumina	Gray to Colorless								Dissolve	Dissolve (Warm)				11
	Gypsum	Gray to Colorless		Medium	Shatters	May Have Crystals				Dissolve (Warm)					
	Manganese Dioxide	Brown to Black	Opaque		Gritty		Brown			Dissolve in Concentrated				11	
	Foam Spots	Yellow Brown to Colorless	Opaque. Translucent Rings	Soft		Circular									
MILL DIRT	Coal & Carbon	Black	Opaque	Medium	Shatters	Conchoidal	Black								
	Cinders	Black	Opaque	Soft to Hard	Shatters	Scalelike to Porous									
	Oil or Grease	Dark to Light	Trans-lucent	Soft									Dissolve Slightly	7	
	Slime	Brown to Colorless	Trans-lucent	Soft	Stringy or Flaky						Dissolve				8 & 12

carried out only in the absence of glass—for example, on a celluloid or bakelite slide, in a platinum crucible, on a platinum foil, or on a piece of wood. Microscopic observations should be made with as long a focal length objective as possible and only after suitable protection with a cover glass attached to the objective with a drop of glycerine or cedarwood oil.

11. Ten per cent sodium metabisulphite is a solvent for manganese dioxide specks.

Chemical Tests

1. One-hundredth *N* iodine solution. The reagent consists of 1.3 grams of resublimed iodine and 1.6 grams of potassium iodide per liter of water. Starch is stained a deep blue and dextrin a wine red with a small drop of the solution.

2. Any of the iodine-iodide metallic salt stains used for fiber identification. Add a drop of the stain to the speck on the slide, cover with a cover glass, let stand for one minute, drain off the surplus, and examine under the microscope. This will show whether or not the speck is a cellulosic material; the color reaction with shives will vary according to the degree of purification and the type of iodine-iodide metallic stain selected, from yellow to gray violet to violet purple.

3. Phloroglucinol solution. The reagent consists of 2 ml. of a 5% alcoholic solution of phloroglucinol mixed with 1 ml. of concentrated hydrochloric acid before use. Add a drop of the solution to the speck on the slide, let stand for one to two minutes, drain off the surplus, and examine under the microscope. Lignified tissues (shives, bark fibers, etc.) are stained a dark red. For outer and inner bark and knotwood, the reaction is slow and the color develops in spots. Shives from mechanical pulp are stained much darker than those from chemical pulp, and the color reaction depends upon the degree of delignification of the shive.

4. Millon's reagent. Dissolve 5 grams of mercury in 6.5 ml. of concentrated nitric acid, and dilute to 45 ml. in water. Add a drop of reagent to the speck on the corner of a slide and warm gently over a microflame. Casein gives a brick-red color.

5. Raspail test. Moisten the speck with a strong solution of sugar, remove the excess with filter paper, and add a drop of concentrated sulphuric acid. Alum-rosin size spots produce a raspberry-red color; inner bark, knotwood, resin, and pitch are colored a brown-red; and plain rosin and rosin-clay spots show a red-brown color. Rosin size spots give a much stronger reaction with this test than rosin-sized papers.

6. Bleaching powder solution. A clear solution of calcium hypochlorite containing about 5% available chlorine (made by adding one part of bleaching powder to seven parts of water and filtering) may be kept in a stoppered amber bottle away from light for a long time. When used, the solution is acidulated with acetic acid by adding one drop of glacial acetic acid to 15 drops of the bleaching solution. A drop or two of this solution will decolorize bark, knotwood, shives, and slime specks. However, the reaction is very slow.

7. Ten per cent potassium cyanide. If the speck is copper sulphide (dendritic growths) it will, when treated with a drop of this reagent, first become colorless and then gradually develop a bright-yellow color. [Potassium cyanide is very poisonous. Under no circumstances should acid be added to the solution, because hydrocyanic acid is formed.]

8. Concentrated nitric acid and ammonia. Add a very small drop of concentrated nitric acid to the speck, warm the slide, and make slightly alkaline with ammonia. Copper compounds produce the deep-blue copper-ammonia complex. Iron yields red ferric hydroxide. Rust and pipe scale do not react with this reagent.

9. Ferrocyanide test. Warm the speck on the slide with a drop of 10% hydrochloric acid and add a drop of 2% potassium ferrocyanide. Rust and pipe scales yield the blue ferrocyanide, iron specks give a weak reaction with this reagent, and copper specks yield the brown ferrocyanide but for copper, a concentrated solution of nitric acid is better.

10. Ferricyanide test. To the speck on the slide add a drop of 10% hydrochloric acid and then a drop of 2% potassium ferricyanide. Copper alloys yield brown ferricyanide, and iron specks, rust, and pipe scale the blue ferricyanide.

11. Potassium acid sulphate. To test for alum spots in material which is soluble in water, add to the aqueous solution a grain of solid potassium acid sulphate and allow the drop to evaporate very slowly. Characteristic octahedral crystals of potassium alum separate. The test may be applied to alumina specks by dissolving in hydrochloric acid and adding potassium acid sulphate.

12. India ink smear test. Slime-forming bacteria can usually be detected in samples of slime stock if an India ink smear of the latter is stained and examined under an oil immersion lens. The stained smear is prepared as follows: Place a small quantity of the slime sample near one end of a clean glass slide. Add an equal volume of India ink and mix thoroughly by means of a clean needle or glass rod. Spread the mixed sample evenly by means of a second glass slide (uniform film is very important) and allow it to dry. The color should be grayish rather than black. Fix the dried film by passing the glass slide (film side down) two or three times through a hot gas flame. Then stain the fixed film for 45 seconds in 0.1% aqueous carbolfuchsin, after which wash off the stain carefully and allow to dry. Slime-forming bacteria have well-defined capsules which appear unstained but sharply outlined against the India ink background. Inside the capsules will be found pinkish-stained cells of bacteria.

13. Biuret test. Proteins treated first with a solution of copper sulphate and then with a sodium or potassium hydroxide solution give red and violet colors. The value of this test consists in the fact that it gives a fully negative result with rosin size. The test is best carried out under the microscope. The speck on the slide is wetted with a 2% solution of copper sulphate, and after four to five minutes a drop of 5 to 10% solution of alkali is added from the end of a glass rod. The violet shows best after the slide has been drained by setting it on edge.

14. Asbestos fibers are unchanged by ignition and are inert to all common reagents. They are decomposed by fusion with sodium carbonate.

15. Graphite is inert to almost all reagents. It burns almost completely on ignition, with loss of black color.

Acknowledgment

The authors want to thank those in the industry who have assisted with many valuable suggestions during the preparation of this chart.

Diatoms in Paper Manufacture*

By H. W. Hall[1]

Abstract

This paper deals with the use of specially processed diatoms and their effect upon the physical properties of newsprint and kraft liner.

The figures presented in this paper were accumulated from actual plant operations and should be indicative of the results that are obtainable in most mills.

The increase of machine efficiency is directly attributed to the presence of diatoms.

For many years diatoms have been playing an important part in paper manufacturing, but it is only in the last few years that they have been used directly in the furnish or stock to accomplish a definite purpose, such as giving the paper product some desired characteristics—e. g., better finish and opacity, to assist in the paper manufacture by their effect on several phases of the manufacturing processes and equipment. It is the object of this discussion to relate experiences which will definitely show how diatoms are assisting the production of paper through this possible increase in operating efficiency and reduction in cost of finished product.

Before going further into this discussion, let us point out that it is known there are many shapes and forms of diatoms, and also various methods of treatment that have a direct bearing upon the papermaking characteristics of the diatoms as they appear to the paper manufacturers. Diatoms acicular in structure should have some effect on the paper in which they are a constituent and this effect is directly attributed to the light weight—approximately 15 pounds per cubic foot—wet density, and the high surface area which the diatoms afford. The effect of their presence in the paper stock and in the finished paper product are the points of interest in this discussion.

Pitch Control

The elimination of pitch as a trouble maker in the paper production is important because of the limitations placed on color specifications of the finished papers.

Pitch can be dispersed in the beater and carried through the papermaking operation without causing any reduction in the operating efficiency by the addition of properly treated diatoms at the beater in the form of a dry powder. The agglomeration of diatoms and pitch causes two things to happen. First, the tackiness or adhesive value of the pitch is materially reduced and, secondly, the melting point of the pitch is raised. This means that if the pitch is dispersed in sufficiently fine particles, to which are added diatoms, these particles will either be eliminated by going through the wire, or they may be carried over in the finished paper. Since their particle size is so small and since the melting point of this mass has been raised, the tendencies of the pitch content of the pulp to cause a reduction in the quality of the paper is materially reduced.

The number of breaks on a machine are cut down, the number of cleanups and washups are reduced, and no "spotting" is evidenced in the dried paper.

Normally, to achieve a satisfactory result, diatoms are added to the stock at the beater in a quantity approximating between ¾ and 1½% of the weight of the fiber.

There are two schools of thought as to the best time to add the diatoms to the beater. The first is of the opinion that the material should be added in the early stages of beating, and the second is of the opinion that better results can be obtained if the diatoms are not added until about ten minutes before the beater is dropped.

Records of experience indicate that it is possible to get better results by adding the diatoms to the beater, in those papers where size is used, after the size has had an opportunity to act. Otherwise, the experience which has been noted to date does not seem to indicate that the first procedure is better than the second. Some mills are getting satisfactory results with one procedure and others with the second procedure. Water temperature and the condition of the water seem to have some bearing on which procedure works better.

It is not the intent of this discussion to get into the phase of the pulp condition and its changes from season to season.

Slime

The development of slime in mills using groundwood and straw stocks is a condition that is being treated daily. However, if a small percentage of diatoms are carried in the stock it is possible to reduce the rate at which this slime builds up and, therefore, improve the quality of the product and operating efficiency of the paper machine.

It is the opinion of a number of paper men that the diatoms disperse the slime in much the same manner, but perhaps to a lesser degree, as they do the pitch, and this procedure would make possible the carrying of the dispersed slime through into the sheet and by so doing keep the slime from building up in the system, eliminating any breaks from this source, and guaranteeing a cleaner system at all times. For this purpose diatoms should be used in the stock at approximately 2% of the weight of the fiber. A greater percentage will give better slime results and at the same time produce other operating characteristics which we will discuss below.

Drainage and Drying

In most recent years the filtration characteristics of diatoms have been used to assist the manufacturers of paper by making possible a more rapid rate of drainage and also a more rapid rate of moisture vapor release as the sheet is carried through the driers. This advantage is possible in most pulps; however,

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there are some pulps which show up more efficiently than do others.

The cost of drying lightweight papers is important and has a bearing on the entire production, but it is in the heavier grades that the drying characteristics of papers containing diatoms have proved most interesting and beneficial.

It is believed that figures showing the effect of the inclusion of diatoms in a news sheet and in a 16-point kraft test liner will be most interesting because of the definite increase in the machine speed, or because of a substantial reduction in the steam consumption with improvements of the physical properties of the lighter papers and no material effect on others.

In Fig. 1 you will note the line numbered 100 is the standard used as a basis and represents data obtained from the paper normally made on these particular machines and are average figures over a reasonable period of time.

The figures above and below the line 100 express the percentage of increase or decrease in the various characteristics under discussion and are based on the average of figures taken over sufficiently long runs to give a definite indication as to what is obtainable.

For practical purposes the quantity of diatoms added is limited to 6% and figures were recorded for those papers containing between 3 and 6%. The retention of diatoms dropped slightly as the concentration increased, but in no case was it less than 64%.

The diatoms were added to the newsprint stock in the form of a water slurry at the stuff box ahead of the fan pump. At the concentrations indicated on the chart, there was no dusting on the rewinders and the characteristics of the paper were improved.

At 6% concentration, the opacity of the sheet was improved 30%, the finish 25%, the densometer 25%, the caliper 13%, and the drying capacity of the machines involved was increased by approximately 8%. The tensile at 3 and 4% is equal to, or better than, the tensile of the papers made from standard furnish but does drop approximately 2% as concentration of the diatoms approaches 6%.

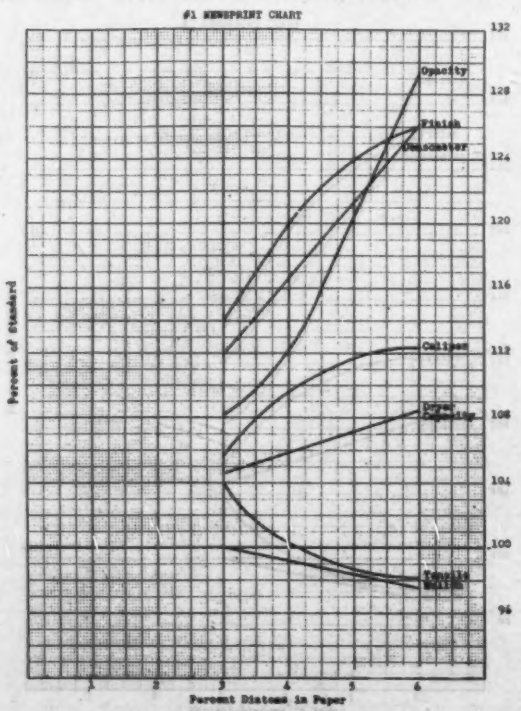

FIG. 1.
Newsprint

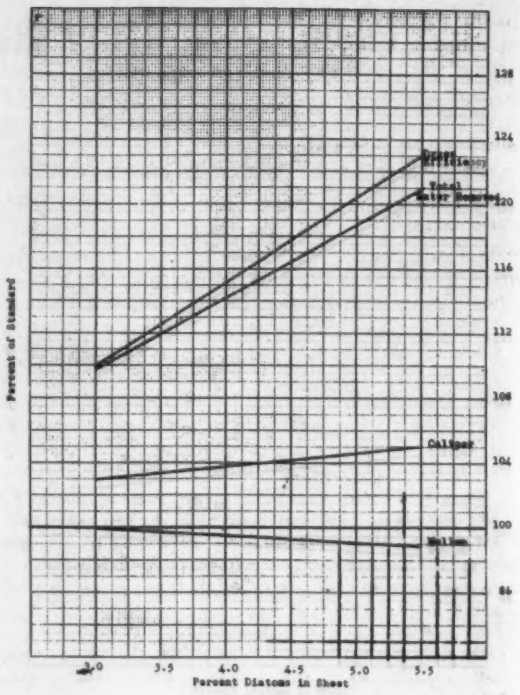

FIG. 2.
Kraft

The burst is effected slightly by the presence of the diatoms, but in no instances are they effected to any appreciable degree. The maximum effect was obtained at 6% diatoms concentrations and shows a drop of 2% on this lightweight sheet.

With reference to the use of diatoms in such furnishes as go to make up kraft test liner, Fig. 2 shows the burst, caliper, moisture content, and drier efficiency. The drier efficiency at the 5½% concentration of diatoms in the finished paper was increased approximately 23%. The moisture content of the paper dropped, which is a factor that should be considered as an additive quantity when discussing drier efficiency, and expressed in percentage of the moisture content of the normal furnish papers, is approximately a 21% increase.

The caliper of the sheet increased as the concentration of diatoms increased, reaching a maximum of 5% at a 5½% diatom concentration.

It might be added here that the caliper of the sheet was of such a magnitude on the initial stages of the run, that it was possible to increase the degrees of refinement the stock was receiving, which would offset a great portion of the increase in caliper but which did show its effect in maintaining good bursting strength. The burst of this paper, as indicated by Fig. 2, did drop approximately 1½% at a 5.5% concentration of diatoms. It might also be added that the machine speed, during these tests, was increased during the latter stages and an increased rate of production was maintained at a 11.6% above normal average speed.

To indicate that the drainage from the wet stock

on the wire was better, it was noted that there was a reduction in the suction box vacuum and also a reduction in the suction on the suction rolls. This remained almost constant after 4% of diatoms were in the sheet and the drop was approximately 6½% in suction at both points.

The diatoms were added to the kraft furnish in the same manner as they were in the newsprint furnish—i.e., in the form of a water slurry at the stuff box, and on this type of paper, and under particular operating conditions upon which these figures are based, the retention on the diatoms was between 76% at the lower concentrations and 73% at the higher concentrations.

In comparing the steam consumption, the burst, and the percentage of moisture in the sheet, it can be seen that the diatoms do offer the paper manufacturers—especially the manufacturers of heavier sheets—an opportunity of increasing their mill capacity and reducing the unit cost of their products.

While every mill is not confronted with the same problem and does not have the same pulp, the average figures indicate that if the proper type of diatoms are added to the paper product, the figures outlined in this discussion will be approximated.

Enzyme Conversions*

By E. P. Gillan[1]

Abstract

The nature of enzyme conversions of cornstarch is described and suggestions are given as to how they may be controlled to give a product that will be consistently uniform and suitable for tub sizing.

This paper, of necessity, cannot be a complete coverage of all that is known of enzymes and their action on starch, a fascinating subject, which, if pursued along all its byways, would lead us far afield from its application to papermaking. I shall confine myself only to what I have gleaned from personal experience with enzyme conversions in large scale plant operations and with the laboratory research attendant upon their development. This experience has been almost continuous since 1919 and has included products ranging from a high maltose-content syrup to modified starches, largely for adhesive purposes.

During the past few years the converting of starch with enzymes has received considerable attention in the paper industry, and the results have not always been wholly satisfactory, particularly with cornstarch. The interest in converting low-priced starches came about originally because of the comparatively high price of chlorinated starches, and later because it was felt their production might be restricted or abandoned altogether. Similarly, an interest in cornstarch for conversion with enzymes came about when it was thought that tapioca starch would no longer be available, the supply limited, or the price prohibitive. Cornstarch has proved highly satisfactory in some cases, so much so that it will not be displaced by chlorinated starches or tapioca when the supply or price of either or both returns to normal or prewar standards.

There is undoubtedly a strong case for enzyme conversions and complete satisfaction in the results if they are given the proper time and attention. To be sure, chlorinated starch needs only to be cooked with a definite amount of water to produce a paste of uniform viscosity and character. Enzyme conversions require a little more time and more careful control, a control which, however, becomes routine when once established. The manufacture of chlorinated starch is far more delicate and involved and requires much more time and technical attention, all of which is reflected in its price. When the paper mill elects to make its own conversions from a much cheaper starch rather than to buy a starch already converted by its manufacturer, he must expect to consume at least a part of the price differential in time and more skilled supervision.

There will be fewer failures and greater interest in enzyme conversions if their nature is fully understood, and it will be the object of this paper to bring this about. What are the qualities of native starch which are to be modified or altered by the action of the enzyme? What is the nature of the modification and what are the results sought? In what way does the enzyme bring this about, what is the procedure and how may the action be controlled to insure uniformity in the resulting product? And to this might be added, what is the essential difference between tapioca and cornstarch which makes the latter so resistant to enzymes?

TABLE I.—GELATINIZATION TEMPERATURES OF STARCH

	Definite Swelling		Gelatinization: Start		Gelatinization: Complete	
	°F.	°C.	°F.	°C.	°F.	°C.
Potato	131	55	140	60	147	64
Tapioca	136	58	145	63	155	68
Corn	149	65	158	70	167	75
Rice	158	70	167	75	176	80
Wheat	140	60	149	65	185	85

Swelling and Gelatinization

When a suspension of native starch is heated, a very slight and hardly noticeable swelling takes place at a point some 8 or 10° F. below that of "definite swelling." It will be apparent if one attempts to pass the starch suspension through a No. 17 silk sieve. This may be termed the temperature of "incipient gelatinization." The swelling increases rapidly as the temperature rises and reaches its peak or point of maximum viscosity at that of "complete gelatinization." Upon continued heating the paste thins somewhat, but not to any great extent until it is boiled, which results in the mechanical breaking of the gel with a deposit of "sludge." All this is best observed at concentrations no higher than about 7%. With concentrations above that (assuming of course that no enzyme is present) the paste will be too heavy at its point of maximum viscosity for proper agitation or uniform heat transfer. The completely gelatinized and fluid starch "solution" will set to a rigid gel on cooling and standing, the increase in viscosity as the temperature falls being most pronounced.

The above features of native or unmodified starch constitute both its strength and its weakness, depend-

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ing upon the use to which it is to be put. Where a thick gel or paste of low-solid content is desirable, or not objectionable, or where it can be distributed in its ungelatinized state, later to impart great bonding strength upon gelatinization with a minimum amount of water, it is obvious that these features of native starch are of great value. Examples are its use in beaters, as the adhesive in the manufacture of corrugated board, pie filling, salad dressing, etc. But the necessity for such a large amount of water to attain a paste of sufficient fluidity for application to a surface, the small amount of solids which result on drying and the fact that it gels with the slightest fall in temperature, shuts it out from many industrial applications.

In thin-boiling or acid-modified starch much heavier concentrations may be used, but all the other features of native starch are unchanged, including that of "setting back" to a gel. The dextrine or acid-roasted process effects a modification of starch that, in the case of yellow or "Canary" dextrines, is virtually complete in the elimination of set-back, viscosity stability at room temperatures, and fluidity at high concentrations. But it is no longer starch and it has none of the properties of starch. It is a dark colored dextrine, completely soluble in cold water. The partially dextrinized "white" grades are merely mixtures of soluble dextrine and modified starch, the latter still retaining the set-back or gel features of native starch. Only in chlorinated starch or in the product of a properly conducted enzyme conversion is the viscosity or body of the starch reduced so that it is fluid at high concentrations, exhibits no tendency to gel, or at least has this property controlled to the desired point and presents a homogenous film on drying. That is the function of the enzyme in an enzyme conversion for the paper mill or for adhesive purposes in general.

Amylopectin and Amylocellulose

The starch granule is composed of two fractions which have been termed alpha- and beta-amylose or amylopectin and amylocellulose, the latter often referred to simply as amylose. Sometimes they are called the "insoluble" and "soluble" portions, terms which are descriptive in a general way; but starch in any form is not soluble in the true meaning of the word. A third or gamma fraction of interest to those engaged in fundamental research, need receive no consideration here. I shall use the terms alpha and beta.

The alpha fraction is responsible for the high viscosity of a starch paste and for the gel. The beta portion produces a uniform colloidal solution, is capable of fairly high concentrations, will not gel and presents a continuous film on drying. A starch paste, then, may be defined as a homogenous, colloidal solution of beta-amylose, rendered viscous by alpha-amylose. The proportion of alpha- and beta-amylose in cornstarch varies and seems to be determined by conditions under which the corn is grown. Variations in the manufacturing process seem to have no effect on the amount of alpha-amylose in native or pearl starch which usually runs about 30% of the starch granule. It has been found to be present in amounts as low as 10% and as high as 60%, but these figures are unusual. If the beta form could be separated from the alpha, or if a starch could be produced commercially that would consist entirely of the beta fraction, it would have many commercial applications. It could be applied at high concentrations and would present a continuous film on drying.

Function of Enzyme

The function of the enzyme, then, in preparing a starch for tub sizing, calendering, and perhaps coating in the paper mill, and for other similar purposes, is to convert the alpha portion of the starch to a condition approaching the beta, if not actually identical with it, either completely or to some intermediate point as determined by the requirements of the paper mill. The action of the enzyme, however, must be confined solely to liquefaction of the alpha fraction, the beta being left unimpaired. At one time this presented some difficulties, not, however, insurmountable. Malt diastase, the best known enzyme and the only one then available, contains either two enzymes or manifests itself in two ways under the proper conditions. Under its action, the beta fraction is converted directly into dextrines and then into maltose. The alpha fraction is liquefied to a condition similar to the beta after which it may be converted to dextrines and maltose. The literature on the subject is not in agreement with this, giving about 80% as the ultimate maltose content that can be attained from an enzyme conversion of starch. The balance which reaches only as far as the dextrine stage is said to be derived from the alpha fraction. But we have found this to be due only because of failure to achieve complete liquefication of the alpha fraction, an aspect of enzyme action that has been given but little attention by investigators who seem concerned only with sacharification. We are not interested in either dextrines or sugars, except that we do not want them present, but I have discussed the mechanics of their formation to show the importance of liquefaction with which we are vitally concerned.

Liquefaction

Fortunately, enzymes are now available, which are not only of standard strength or potency, but whose action is confined almost entirely to liquefaction. Furthermore, while sacharification can only take place on a starch which has been gelatinized, liquefaction starts as soon as the point of incipient gelatinization is reached, and continues to the temperature at which the enzyme is destroyed if a margin of unliquefied material still exists at this point. Complete gelatinization, however, must have been attained before the enzyme is destroyed or the liquefaction will not be complete. Neither will it be complete if sufficient time has not been given at each point of the rise in temperature from the start of gelatinization, for it is characteristic of all enzymes that a function is performed at each point in the temperature rise which is destroyed after that point is passed. The time element from the start of gelatinization to its completion is of vital importance, if enzyme conversions are to be satisfactory and uniform. It must be sufficient for the enzyme to do its work, and a standard must be maintained to insure uniform results. The enzyme manufacturers have done an excellent job in the production of suitable and standard enzymes. They have done much to simplify the process of conversion, but in their anxiety to come as near as possible to the simple cooking required for chlorinated starches they have rather overstepped themselves in their recommendations as to the use of their product. More time and

attention must be given to the initial stages of the conversion.

I have stated that complete gelatinization must be attained before the enzyme is destroyed if liquefaction is to be complete, or at least satisfactory. The gelatinization temperatures of corn and tapioca starches are 167 and 155° F., respectively. (Table I) When tapioca starch was in general use for enzyme conversions, the enzymes employed attained their maximum activity at 158° F. and were completely inactivated at 165° F. Tapioca, therefore, with its point of complete gelatinization of 155° F., was a "natural" for these enzymes, to say nothing of the fact that root starches are by their very nature more susceptible to enzymes than those derived from grain. Cornstarch, on the other hand, attained complete gelatinization only after the enzyme was destroyed. To use corn starch successfully only two courses were open—to depress its gelatinizing point to conform with the enzyme or to produce an enzyme which would be active at the higher temperatures. This the enzyme manufacturers have done, but the cornstarch manufacturer also has contributed to the solution of the problem. Each manufacturer has developed his own method for conditioning cornstarch for enzyme conversions. I have found all such starches satisfactory and with all the enzymes recommended for this purpose, but the results are slightly different in the nature of the resulting product. The paper mill operator should choose the enzyme he finds most suitable for his purpose.

Without going into any detail as to the methods that are or might be employed to condition cornstarch for enzyme conversions, which would be out of place in this article, I may say that the primary and all-important feature cornstarch should possess is uniformity. Now, cornstarch granules are not all of the same size, nor do they reach the same stages of swelling or gelatinization at the same time. The cornstarch manufacturer cannot control the granule size, variations of which are reflected in the time or temperature a granule arrives at a given stage of gelatinization. But granule size is not the only factor in this respect. There are other controllable factors, by means of which a cornstarch can be made which will perform with uniformity under the action of enzymes, at least in this most important phase of the conversion.

Activators and Retardants

The presence of extraneous nonstarch substances, both organic and inorganic, in amounts that may be termed minute, have a decided influence on enzyme activity, either as activators or as retardants. If activators, their presence would seem to be an advantage, either in shortening the converting time or permitting the use of less enzyme. This immediately suggests the addition of activating substances to the starch or the suspension. The presence of activators or retardants in an enzyme conversion, whether as "impurities" in the starch or by purposeful addition, is fatal to the attainment of a uniform product unless perhaps accompanied by an elaborate control of the conversion, which we are trying to avoid.

Water

The shorter the converting time, and more rapid the action, the more difficult and less sensitive is the control, and the same thing applies to lesser amounts of enzyme. But of far greater importance is the fact that the amount of activating or retarding impurities in starch can never be controlled with the degree of sensitiveness necessary for uniform conversions. This applies to chemicals which might be added to starch or to the slurry as well as to nonstarch substances derived from corn and not completely removed. My personal belief is that uniform and satisfactory results with enzyme conversions are best attained with starch that is as free as possible from all nonstarch substances, and with water that as nearly as possible approaches distilled. All I have said of impurities in starch applies also to the water in which it is suspended, though this much may be said for the water—that it will probably always be uniform at any one mill.

Conclusion

This paper should conclude with some specific suggestions and recommendations applicable to mill operations. In a general way these can be made, particularly as to the application of the theories just discussed, but in the last analysis the technique of enzyme conversions in a particular mill must be worked out by its operators. Only they know the peculiarities and limitations of their equipment and what they want in the product. This paper is merely my contribution to the general knowledge of the subject.

The starch suspension should first be adjusted to a pH of 6.5, and the temperature raised by means of live steam introduced through a Pemberthy injector. The enzyme may be added to any point before the temperature reaches 100° F. I prefer adding it at 100° F. From that point on a definite time schedule should be followed, and the temperature raised uniformly and *not too rapidly* to 158–160° F., or when the starch begins definitely to thicken. I would suggest a period of 30 minutes for the rise from 100 to 158° F. Starch concentrations of 30% or over require as high as 50 minutes in order to derive full advantage of the enzyme action during the earlier stages of gelatinization, otherwise the paste will be too thick for proper agitation when it reaches 158–160° F.

The paste is held at 158–160° F. for 15 minutes, during which there is a pronounced thinning. The agitation should be sufficient to effect a rapid distribution of heat throughout the batch during the thickest stage. After 15 minutes at 158–160° F. the temperature is raised over a standard time period of not less than 15 minutes to 166–168° F. which may be termed the "converting" temperature.

At this temperature the batch may be held from 15 to 30 minutes, depending upon the viscosity desired. This viscosity is also controlled by the amount of enzyme used. The action is most rapid during the first 15 minutes and slows down considerably at 30 minutes. This is true for all but one of the enzymes studied. For this reason I prefer a converting time of 30 minutes, controlling the viscosity by the amount of enzyme used.

At the end of the converting period, the temperature should be raised to 200° F., and held for at least 5 minutes before the batch is used.

If this procedure is followed, enzyme conversions should be perfectly satisfactory and consistently uniform. It may take a little experimenting and a little patience to adapt them to the equipment and needs of a particular mill, but after that they should present no difficulty.

The Flow Spreader*

By Samuel M. Bratton[1] and Frank M. Sanger[2]

Abstract

Currents, dead spots, accumulation of fibers resulting in flocculation, uneven formation and distribution by the headbox are eliminated by the flow spreader which receives the stock at one point and by a hydraulic nozzle carefully designed distributes the stock to the slice evenly, thereby eliminating the currents, dead spots, etc., resulting in the formation of a sheet of paper of more even caliper and bursting strength.

Introduction

The "flow spreader," as we term it, is a section of a paper machine to evenly spread the stock the full width of the machine as it approaches the formation point, keeping the currents under control thereby giving the slice an opportunity to gage the thickness of the sheet without any interference from irregular actions such as found in the previous methods of distributing the stock to the forming point.

Difficulties in formation have been brought about by increasing the speed and width of the machine. When the speed is increased then all the elements to be controlled are aggravated many times the proportion of increase. The same holds true of the increase in width. Multiply these two factors together and you have the problem of today when both speed and width are demanded.

As machine widths and speeds have increased the volume of paper stock required has increased and it has become more and more difficult to obtain satisfactory flow. As widths increased it became more difficult to spread the flow across the full width without introducing cross currents. In order to overcome this operators resorted to multiple feeds to the headbox. This caused unequal velocities between the points of flow and dead spots or eddies as well as cross currents which are extremely difficult to iron out. Dead spots also cause flocculation, and numerous devices have been resorted to to eliminate this condition.

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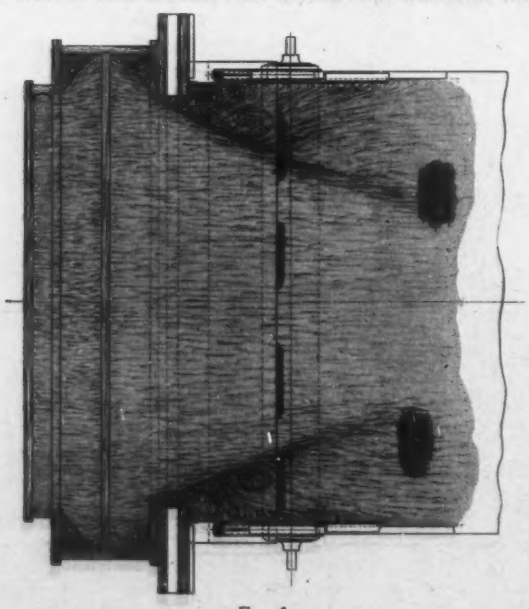

FIG. 1
Effect of Currents on Old Type of Headbox and Deckle Arrangement

Sheet Formation

Uniform Distribution of Fibers

To properly form a sheet of paper, it is necessary to deliver to the forming point or area an equal and uniform distribution of pulp fibers over the entire forming area. Pulp fibers are suspended in large quantities of water and flowed to the forming area. Flow to the forming area must be in the form of a moving mass of water and fiber in suspension of the same width as the forming area and each lamina of which moves at the same velocity and in the machine direction. Distribution of fibers must be uniform so that the same quantity of fibers will be delivered in each increment of the forming area. Parallel flow in the machine direction is essential, because cross currents cause variations in quantity of fiber delivered across the forming area. Pulp fibers are heavier than water and unless kept in motion will settle or flocculate.

Let us consider the type of headbox and slice of years ago. The difference between the inside of headbox and opening and the distance between deckles form corners (Fig. 1) for the stock to settle, causing flocculation and provide ledges that cause currents to flow toward the center line of the machine.

The deckles set at maximum distance would give a different effect than when set the minimum distance.

Flocculation causes a mottled or blotchy formation and settling causes massing of fibers which break away and cause spots in the sheet and, if large enough, breaks at the presses. Formation then may be said to depend on two factors:

1. Uniform flow of the mixture of pulp and water to the forming area.
2. Uniform dispersion of the fibers in the water which is the carrying medium.

One of the first improvements was to make the headboxes the same width as the forming surface. Although this made a great improvement there were still streaks in the formation caused by currents in the stock. These currents were caused by the method of delivering to the headbox. The flow had not been properly spread.

Delivery was usually made from screens or feed pipes to the first compartment sometimes called a knapsack. Where only one screen was used the action of the currents was as shown in Fig. 2. With two screens there was a converging of currents in the center of the machine. With three screens there were two such converging of currents. The use of four screens usually makes the overall of the screen open-

ings more than the width of the headbox (Fig. 3). At the same time that more screens were being added, naturally more stock was handled; and with the tendency to use more water, reducing the stock consistency, the current problems became more difficult to solve.

Currents and Turbulence

On machines where screens are not used the stock is pumped direct to the old-fashioned headbox, causing turbulent condition. The stock is usually pumped direct through one pipe to a manifold which in turn has four or five outlets to the headbox, each outlet making a set of currents or turbulences (Fig. 4).

To break up these currents perforated boards, perforated rolls, adjustable partitions, racks and other devices (Fig. 5) which all have a tendency to catch fibers and form lumps were installed in an attempt to even out the flow. Headboxes were used with large compartments resulting in slow flow of stock; under such conditions the pulp fibers suspended in the water become quiet, flocculation and settling occur, resulting in a mottled and uneven sheet. It becomes necessary therefore to keep the mass of water and pulp fibers moving at velocities sufficient to prevent this. This has been accomplished to a degree which will give passable results by installing several adjustable partitions so that the mixture of pulp and water flows over and under these partitions and is alternately speeded up and slowed down as it progresses toward the discharge to the forming point. Turbulence caused by a sudden enlargement or reversal of direction will tend to break up flocculation and give further mixing, but, also results in cross currents and if at the surface of the pond of stock causes entrainment of air which further disturbs formation.

A moving mass of water possesses kinetic energy and any change in its velocity is accompanied by a change in its kinetic energy. This change or loss of energy is absorbed by resulting turbulence or increased friction. It has been proven by experiment that this loss of energy is at a minimum if the rate of change can be kept below a definite figure. A decrease in velocity must be accompanied by an increase in area, and if that rate of increase of area is kept below a certain maximum then a quiet uniform flow will result.

Slices

An article was published in Technical Association Papers 24:510-518, 651-655 (1941), where various slices and headboxes were discussed. (Other articles by G. D. Bearce, A. M. Lund, M. O. Neilson and J. T. Jaeger have discussed this subject also.) One important point has been brought out, other than the breaking up of the currents, why the stock should be conveyed to one central point—i.e., if more than one screen is used there will be just as many different degrees of screened stock. The plates will usually be slightly different, some more worn than others, and should the front side screen have new plates and the back side screen worn plates then there will be a difference in the formed sheet. The quantity of shower water will also vary.

To bring the different grades of screened stock together as well as all currents the screens discharge into a hopper (Fig. 6) with one outlet which is equipped with a choke valve that holds the level at the screen discharge to prevent cascading regardless of the head or pressure at the slice. The latter of

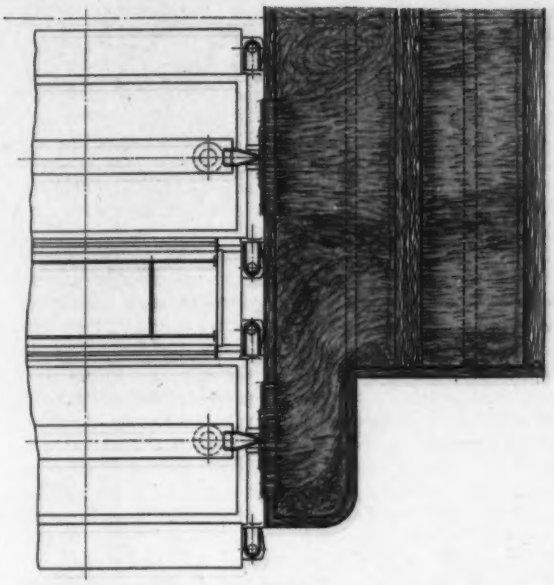

Fig. 3
Current Effect from a Four-Screen Installation. (Only one half shown)

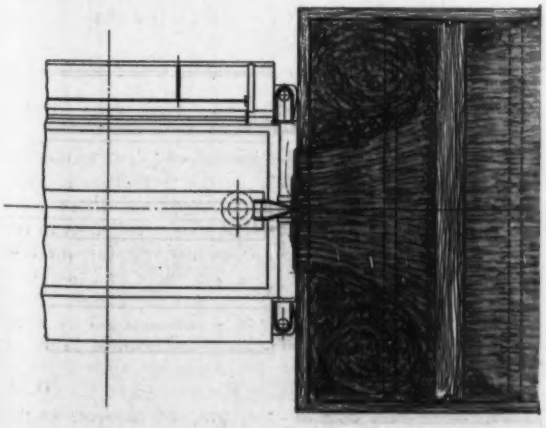

Fig. 2
Currents Originating in Flow from Single Screen

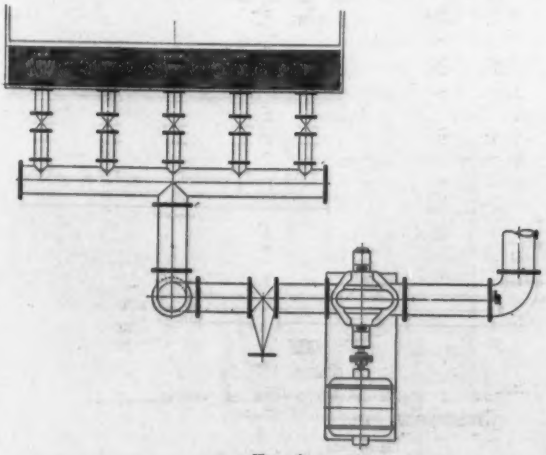

Fig. 4
Five Inlets to First Compartment of Headbox

course varies with the speed of the machine which leads to the beginning of the flow spreader.

The Flow Spreader

The flow spreader may be described as a carefully designed hydraulic nozzle. The opening at the slice being in the form of a rectangle it is necessary to start the flow spreader in a rectangular form by using a transition fitting at the inlet end to change the flow from a circular cross section pipe to a rectangular section of the same width as the pipe diameter and of the same area. The flow spreader changes this rectangular section progressively and gradually to the full width of the machine with a corresponding reduction in depth. The discharge area is usually less than the inlet area. The spreading length is according to the width of inlet and spreading angle within limits that will permit uniform spreading of the flow. It has been shown that a rectangular pipe, two opposite sides of which are parallel, and the other two diverging will produce minimum turbulence if the angle of divergence is kept below a definite limit. If the two parallel sides are made to converge so as to maintain the same area or reduce the area the divergence angle of the other two sides may be increased accordingly. This principle has been utilized in the design of the *flow spreader.*

Engineering Materials

The flow spreader is made of steel or cast iron, two opposite sides of which diverge at a constant angle to full machine width, and the other two sides converge so as to give slightly decreasing area or increasing velocity of flow to the point of discharge to the slice. It is usually folded on itself to conserve space (Fig. 7) and rubber or neoprene lined to prevent corrosion and facilitate cleaning. This folding on itself results in 180° turns at the top and bottom of each pass. The top of each pass constitutes an ideal type of air trap. Air trapped at this point is continuously vented to the atmosphere by means of one or more generous sized pipes leading upward to a height sufficient to prevent flow of stock. The rubber or neoprene lining provides a smooth surface of a character to which pulp fibres have little tendency to cling, and is easily washed. It is corrosionproof and cannot contaminate or dirty the stock, and by preventing any contact with metallic surfaces insures long life for the equipment. All joints are carefully formed so as to prevent ledges or corners where stock fibres might hang up, or cause disturbances of the flow. The flow spreader keeps itself clean by the uniform velocity

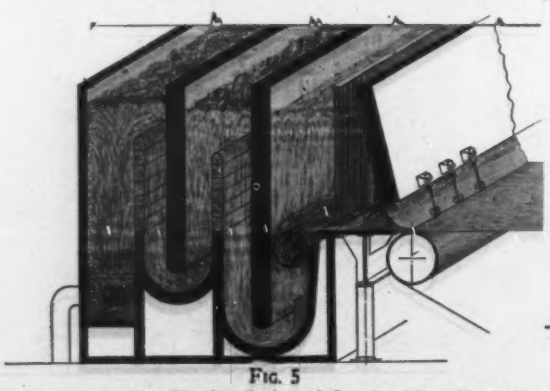

Fig. 5
Section of Headbox Showing Perforated Boards, Adjustable Baffles, Perforated Rolls and Racks

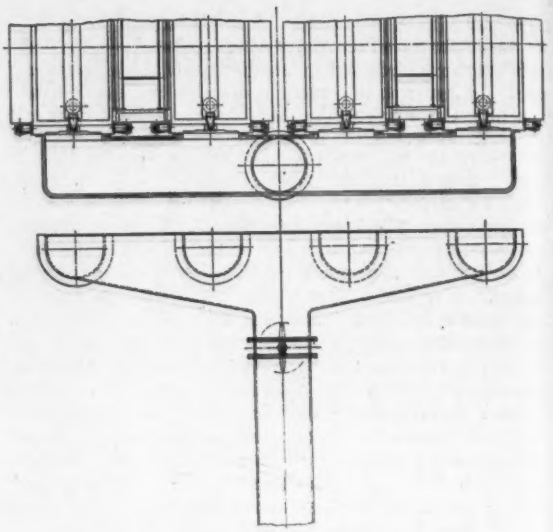

Fig. 6
Multiple Screen Hopper with Single Discharge

but ample provision is made for easy washup or inspection by means of quick opening doors located so that all surfaces can be reached by a direct stream from a hose.

Flow to the flow spreader must be in the machine direction, and any turns or elbows at right angles to

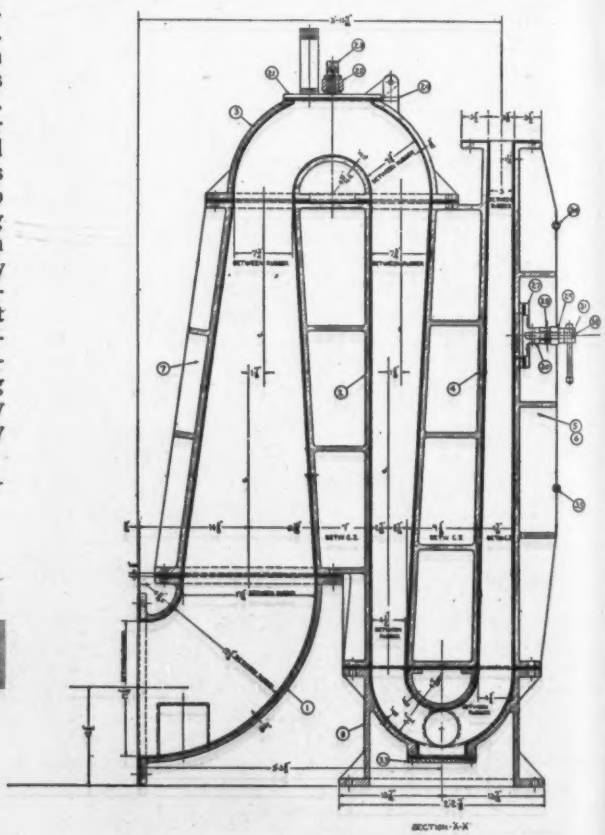

Fig. 7
Neoprene or Rubber Lined Flow Spreader

machine direction must be followed by sufficient straight pipe or other means of correcting any unevenness of flow caused by such turns or elbows.

Flow Spreader on Fourdrinier Machine

When applied to a fourdrinier machine the flow spreader is placed directly below the slice (Fig. 8) and connection made to compartment just back of the slice from which the flow is over an adjustable dam to the slice. Here the area of the connection to the compartment back of the slice is gradually increased to reduce velocity to a point that will not cause turbulence. The adjustable dam is provided to prevent formation of a dead surface at the top of the pond back of the slice with resultant flocculation and settling of fibers. Flow spreaders have been installed on fourdrinier machines from 100 to 210 inches in width, making kraft bag and wrapping, liner board, photographic papers, and napkin and tissue papers, at speeds up to over 1400 f.p.m. Improved and more uniform formation has resulted from every installation, and space around the slice conserved. If the installation has been made with a closed inlet or pressure type of slice, its advantage can readily be seen as the proper functioning of such a slice is absolutely dependent on proper flow to the nozzle. With a closed inlet nothing can be done to correct unevenness of flow other than adjustment of slice lip and variations in adjustment of the slice lip will invariably cause cross currents on the wire which in turn cause streaks in the paper.

Flow Spreader on Cylinder Machine

When applied to a cylinder machine vat the flow spreader is placed under each vat (Fig. 9) and the discharge end connected to the vat by a suitable fitting of full vat width. Discharge velocity from the flow spreader must be reduced either in the connecting fitting, or in approach passages in the vat, before releasing into the open pond at the forming point to prevent turbulence, and this reduction must be at a rate below a definite maximum. The flow spreader will deliver the paper stock uniformly across the entire machine width and a level uniform sheet will be the result.

Wing dams and other makeshifts to level the sheet are entirely unnecessary

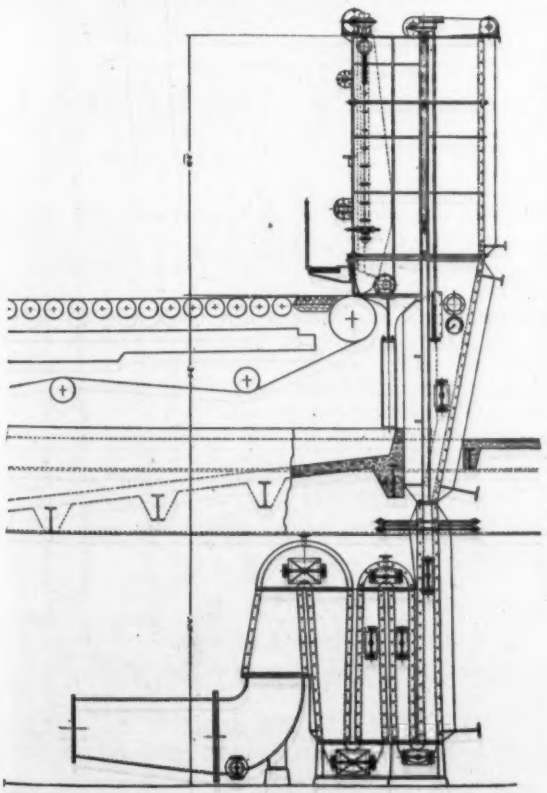

Fig. 8
Flow Spreader and Slice on Fourdrinier Machine

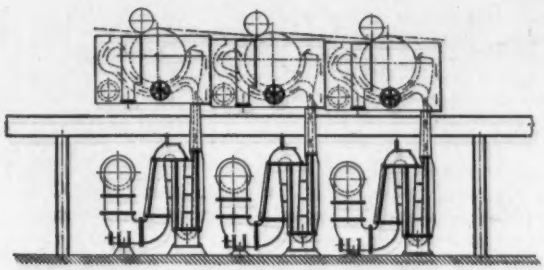

Fig. 9
Flow Spreader and Stream-Flow Vat

Upflow Headbox

To provide uniform dispersion of stock to the flow spreader and eliminate as much air as possible, flow to the flow spreader is through an upflow headbox in which stock is delivered from the pump to the bottom of an inverted cone. It rises in this cone at constantly decreasing velocity and overflows into an outer cone, then downwards in the outer cone and delivered from the bottom of the outer cone to the underfeed pipe and thence to the flow spreader. This provides a headbox in which no dead spots can exist with a quiet pond of large area from which a maximum amount of air can be eliminated. Many such installations of flow spreaders and upflow headboxes have been made on single and multiple cylinder paper machines making rope and kraft specialties, chestnut corrugating boards, roofings, and folding boxboards, and results obtained have more than justified the installation.

The upflow headbox can also be applied to the fourdrinier installation another step in taking out air or turbulence just before entering the flow spreader thereby assuring an even flow and air-free stock to the slice.

Conclusion

On installations already in operation the following points have been noted:

1. More even caliper across the sheet.
2. Less adjustment of slice to eliminate wet streaks.
3. Less flocculation resulting in better formation and bursting strength.
4. Elimination of perforated boards, rolls, racks, and flow eveners, which accumulate lumps thereby reducing the paper breaks.
5. All wetted surfaces rubber or neoprene lined preventing accumulation of slime, almost entirely eliminating shutdowns for washup.

By installing the flow spreader another step is made toward increasing quality and production.

Sodium Hydrosulphide as a Pulping Agent*

By M. A. Buchanan[1] and C. M. Koon[2]

Hanson *(1)* described an experiment (his Cook 43), from which he concluded that sodium hydrosulphide alone will pulp sprucewood; these results were apparently confirmed by Ahlm *(2)*. On the other hand, Hanson quotes Kullgren *(3)* as having obtained yields of not less than 70% when wood was pulped with this agent.

Recently, Hanson questioned the validity of his result and the purity of the sodium hydrosulphide used. Subsequent analyses[3] made on several commercial samples showed a wide variation in actual sodium hydrosulphide content. This is shown in Table I, which gives the results obtained with three samples submitted at different times.

TABLE I.—COMPOSITION OF SODIUM HYDROSULPHIDE SAMPLES

Sample Received	NaSH %	Na_2S %	Nonsulphide Reducing Compounds (calculated as $Na_2S_2O_3$) %
Prior to 1942	none	30.2	3.3
July 8, 1942	65.4	6.0	0.7
July 25, 1942	71.5	0.6	7.1

It is believed that sodium hydrosulphide gradually changes into sodium sulphide. Because of this condition, it is not possible at the present time to determine the actual composition of the material used by Hanson. In view of this uncertainty, an investigation was initiated to determine the effectiveness of sodium hydrosulphide as a pulping agent.

A solution of sodium hydrosulphide was prepared by passing hydrogen sulphide into a 25% sodium hydroxide solution until a slight excess of hydrogen sulphide was present. The resulting solution, which was slightly yellow in color, was analyzed and found to contain 322 grams per liter NaSH, 1.3 grams per liter H_2S, and 4.6 grams per liter Na_2CO_3. A 618 ml. sample of this liquor, diluted to 4500 ml. with distilled water, was used for the first pulping experiment.

Shavings were prepared from a 4-inch diameter black spruce bolt from a tree which had been felled about five months previously. Of these shavings, which had a moisture content of 10% and a lignin content of 29.2%, 240 grams (moisture-free basis) were digested with the diluted liquor in a 5-liter, stainless-steel autoclave under the conditions given in Table II for Cook I. The autoclave was heated in a wax bath.

The black liquor and the digested material had an exceedingly foul odor, which was mentally relatable to boiling onions or to sewer gas. The characteristic odor of a normal kraft cook was not detected. The wood residue was thoroughly washed with hot water. The shavings retained their original entire structure; the foul odor was not removed by washing with hot water. Handling the material left an oily film on the skin.

About 10 grams of digested shavings in 1500 ml. of water were stirred for 11,250 revolutions in the British disintegrator. However, disintegration to pulp did not occur. About 2 grams (moisture-free basis) of the cooked shavings were boiled for 10 minutes in a 2% sodium hydroxide solution. The solution became dark brown in color, but maceration did not occur.

After the first cook was completed, a new sample of "sodium sulphydrate" was received[4]. Analysis of the sample showed it to consist of 71.5% NaSH, 0.6% Na_2S, and 21% nonsulphide reducing compounds (calculated as sodium thiosulphate). Immediately after the analysis, a second cook (Cook II) was made using this chemical, and spruce shavings from the same bolt as was used for the first cook. The same 5-liter autoclave was used and the wood residue was thoroughly washed with hot water. The conditions and the results of the two cooks are given in Table II, which also contains the corresponding data for Hanson's Cook 43.

The wood residue from Cook II retained the form of the original shavings. A sample stirred in the British disintegrator was only partially disintegrated. After stirring, the sample appeared to consist of about equal parts of single fibers and fiber bundles.

TABLE II.—COMPARISON OF DIFFERENT COOKS

	Cook I	Cook II	Hanson's Cook 43
Ratio of chemical to moisture-free wood (expressed as NaOH)	60	40	40
Initial concentration (expressed as NaOH)	3.2	2.1	3.8
Maximum temperature, °C.	170	170	170
Time to reach maximum, hours	3¼	1½	1¼
Time at maximum, hours	2¼	8	8
Yield of wood residue, %	72	64.5	40
Lignin content of wood residue, %	22.9	20.0	2.7
Original lignin removed, %	44	56	96*
pH of white liquor	9.9	10.8	11.3
pH of black liquor	...	7.9	11.2

* Assuming Hanson's original wood contained 29.2% lignin.

The results of Cook II, as shown in Table II, are approximately the same as Cook I, but very different from those reported by Hanson. Except for the source of the chemical and the initial concentration, Cook II was made under conditions identical with Hanson's cook; therefore, it seems probable that his chemical consisted largely of sodium sulphide. Because of the different conditions, a direct comparison cannot be made with Cook I, but the slightly lower degree of delignification obtained in this case may be due to the presence of the small amount of hydrogen sulphide. Hägglund *(4)* has reported an inhibiting effect of small amounts of hydrogen sulphide on the delignification.

It is concluded that sodium hydrosulphide, as such, is a very ineffective pulping agent.

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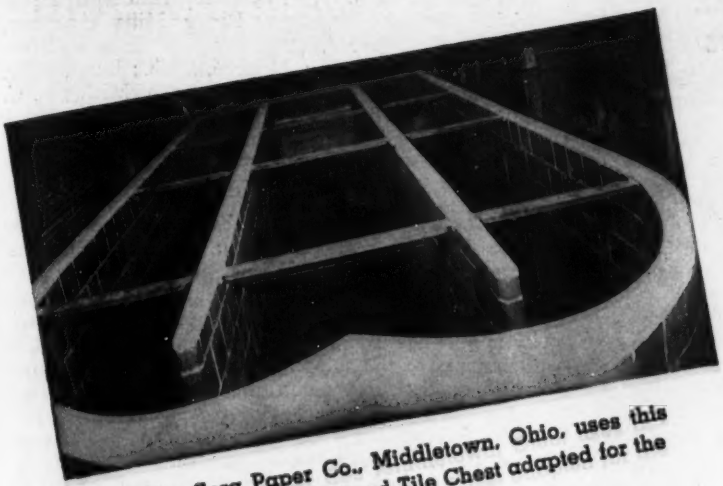
4. Hägglund, Erik, *Svensk Papperstidn.* 44, no. 9:183-191 (May 15, 1941).

[1] Research Associate, The Institute of Paper Chemistry, Appleton, Wis.

[2] Member TAPPI; Research Associate, The Institute of Paper Chemistry, Appleton, Wis. On leave with U. S. Army, Chemical Warfare Service.

[3] All analyses were performed by the Analytical Department of the Institute.

[4] From The City Chemicals Corporation.



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Safety Congress to Meet October 27

The 31st National Safety Congress and Exposition to be held in Chicago, October 27 to 29 inclusive, will be the most important ever held, because of the vital part which is being played by accident prevention in the war effort. The Pulp and Paper Section will hold its meetings in the American room on the Mezzanine floor of the LaSalle Hotel.

The program for Tuesday morning with Clayton O. Braatz, secretary-treasurer, Pulp and Paper Manufacturers Association, Rothschild, Wis., general chairman, will include a "Progress Report"; "Review of 1941-1942 Paper and Pulp Accident Experience" by F. W. Braun, vice-president and chief engineer, Employers Mutuals, Wausau, Wis., and chairman, Statistics Committee, Paper and Pulp Section, National Safety Council; Discussion: "Why Top Management Must Actively Participate in a Safety Program," speaker to be announced. Discussion led by George J. Adams, Industrial Supervisor, International Paper Company, Glens Falls, N. Y.

On Tuesday afternoon in room 102 on the first floor of the La Salle Hotel there will be a group session for pulpwood loggers, J. E. Cantine, safety director, Quebec North Shore Paper Company, Baie Comeau, Quebec, Canada, presiding. "Accident Prevention in Pulpwood Logging and Hauling Operations" will be discussed. Tuesday afternoon in the American room on the mezzanine floor there will be a group session for paper products plants, A. J. Basile, safety director, Lawrence Paper Company, Lawrence, Kan., presiding. D. E. Maynard, manager, Crescent Division, Atlas Box Makers, Inc., Chicago, will discuss "Hazards and Their Elimination in the Corrugated and Solid Fiber Box Industry." Walter E. Strong, manager industrial relations, Menasha Division, Marathon Paper Mills Company, Menasha, Wis., will discuss "Female Labor in the Converting Industry."

Thursday there will be a luncheon at 12:30 o'clock followed by a session at which Clayton O. Braatz will preside. This will include a final report of 1941-42 Paper Industry Safety Contest; Presentation of Contest Awards and a panel discussion on "Range Finders for Safety." E. A. Page, Industrial Relations Department, Kimberly-Clark Corporation, Neenah, Wis., will be the leader and the participants will include: H. H. Aderhold, Department of Industrial Relations, Marathon Paper Mills Company, Neenah, Wis.; W. G. Etter, personnel director, River Raisin Paper Company, Monroe, Mich.; Jane Notley, R. N., Allied Paper Mills, Kalamazoo, Mich.; L. C. Smith, personnel director, Thilmany Pulp and Paper Company, Kaukauna, Wis.

Sales Up in Philadelphia

PHILADELPHIA, Pa., September 28, 1942—With the price situation slowly stabilizing, there is a much better atmosphere prevailing in paper circles here than has been the case for sometime past, particularly is this so in connection with kraft paper. This commodity is now coming in so freely, mostly on account of the control of the shipping situation by convoy ships, which makes for a plentiful supply, and has necessarily brought about a substantial reduction in the price of kraft. This reduction in price is looked upon as a decided advantage by the trade generally, because heretofore the supply, which was so meager occasioned high prices that in reality meant nothing. As it is now, merchants continue to make a reasonable profit because they have well stocked kraft items and are able to serve the trade. With the overhead a fixed element in costs, and the supply of merchandise greatly improved, buying is stimulated and merchants can afford to reduce prices which have maintained, all in hearty accord with the codification of OPA, and in agreement with the wishes of the dealers.

In the waste paper trade, conditions among the packers of paper stock showed some disappointment, and by and large, activity is at a standstill. With these conditions, which have maintained for the last few months, there appears to be no established prices. The mills are reported to be picking up bargains wherever they can and in some instances are competing with dealers. The market is very unstabilized, especially does this apply to the better grades. The summer quiet still prevails, and recovery from the doldrums which the trade experienced in June does not seem to be very imminent.

Paine Family in Armed Forces

Of the four generations of the Paine family that have controlled the destinies of the New York & Pennsylvania Company, New York, during more than half a century as manufacturers of pulp and paper, two are now represented in the armed forces of the United States. A temporary leave of absence has been granted to Vice President Peter S. Paine, according to a company announcement, to permit him to accept a commission in the U. S. Army Air Forces, while Augustus G. Paine II, great-grandson of the company's first president and a member of the company's sales organization, has received a commission in the U. S. Navy and is now attached to the Bureau of Aeronautics of the Navy Department in Washington, D. C.

Active service to the nation in war time is a tradition with the Paine family. The story is told of Col. Augustus G. Paine, founder of the New York & Pennsylvania Company, that at the time of the Civil War, when he was a young merchant just getting his start, he deliberately closed and locked the front door of his establishment for the duration in order to join the colors. Eustis Paine, now president of the company, saw service in France during World War I.

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On the paper mill salvage front, the Bauer double-disc pulper is a prime weapon of waste stock conversion. Kraft knotter and screen rejects, groundwood screenings, and other waste paper materials are turned into A-1 pulp by this fast and economical pulper. We are proud to be the builders of equipment so important to the vital business of waste product salvage. *THE BAUER BROS. CO., Springfield, Ohio.*

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New York Paper and Pulp Market Review

Sales Volume In the Paper Market Is Fair With Little Activity In Some Specialties — Demand For Pulp Improved — Roofing Rags Fairly Active—Waste Paper Sales Light—Prices Are Unchanged.

Office of the PAPER TRADE JOURNAL.
Wednesday, September 30, 1942.

Some improvement in sales in the wholesale market, mainly in kraft paper, is reflected in some of the reports received during the current week from many manufacturers' representatives, jobbers, and general paper merchants. Due to the restrictions and curtailment of most materials and products for civilian needs, the trend in the consumption of paper for this year is expected to be well under the record reached in 1941.

The "apparent consumption" trend, which represents production, plus imports, minus exports, as plotted by the statistical division of the American Paper and Pulp Association, showed a per capita consumption of 112½ pounds in 1917. The increase from this date to 1930 was steady, with a drop during the years of depression. A high record of nearly 300 pounds per capita was reached in 1941, to decline to approximately 275 pounds per capita in the first six months of 1942.

The index of general business activity for the week ended September 19, declined to 131.2%, from 132.9% for the preceding week, compared with 127.3% for the corresponding week last year. Paper board output was 3.3% higher.

Paper production for the week ended September 19 was estimated at 83.9%, compared with 103.8% for 1941, with 88.5% for 1940, with 93.5% for 1939, and with 78.4% for the corresponding week for 1938.

Paper board production for the week ended September 19 was 81.0%, compared with 99.0% for 1941, with 74.0% for 1940, with 93.0% for 1939, and with 68.0% for the corresponding week for 1938.

The OPA Supplementary Order 19, states in part: Effective September 24, 1942, a license as a condition of selling is hereby required of every distributor now or hereafter selling any paper or paper product for which maximum prices are established by Price Regulation No. 114 (wood pulp), No. 130 (standard newsprint), No. 140 (sanitary napkins), No. 182 (kraft wrapping papers and certain kraft bag papers).

A manufacturer who distributes his products or operates a warehouse, branch, subsidiary or affiliate acting as a distributor, is affected. This order supersedes provisions of the General Price Regulation Paragraph, 1499.16, so far as it may be applicable to sales for which a license is required by Supplementary Order 19. The Paragraph 1499.16 of GMPR continues to apply to retail sales.

Wood Pulp

Demand for chemical wood pulp is reported a little more active at this date. Contract prices are unchanged. The removal of restrictions on accumulating inventories is reported to have stimulated buying. Prices are well maintained at ceiling levels.

Rags

Demand for roofing rags continues in moderate volume with prices maintained at the OPA schedule of $31 per ton for No. 1 and $29 per ton on the No. 2 grade. Demand for new cotton cuttings and other grades of new and old rags is currently reported as light.

Old Rope and Bagging

No important change is reported in the old rope market at this date. Mill buying is steady. Prices are firm with No. 1 old Manila rope maintained at the OPA ceiling price of $115 per ton.

No change is reported in the market situation in scrap bagging at this date. Mill buying continues fair. Prices are maintained.

Old Waste Paper

Current mill buying of old waste paper is reported as light. Prices are unchanged on all major grades of paper stock.

Twine

Some improvement in demand for some grades of twine is currently reported for civilian use. Government demand continues quite active in many standard grades of hard and soft fiber twines. Prices are unchanged.

Paper Mill Boosts Scrap Drive

CHATTANOOGA, Tenn., September 28, 1942 — The total in Chattanooga's industrial scrap - for - victory campaign was boosted when it was announced that the Tennessee Paper Mills had provided sixty tons of iron and steel for use in the all-out war production program.

The work of loading the salvaged material to start it on its journey to war plants is now under way. The sixty tons includes heavy paper machine driers, gears, shafting and framing.

L. T. Murphy, production manager of the paper mills, said that the driers, gears, etc., were purchased about three years ago when the company made plans to erect another paper machine in the plant, which is located in North Chattanooga.

"We have decided, because of the great need for iron and steel in the war program, to turn in this material," said Mr. Murphy.

Box Makers to Meet May 16-19

C. W. Reiber of Columbus, Ohio, president, National Paper Box Manufacturers Association, announced that the next annual convention of this organization will be held May 16 through 19, 1943, at the Drake in Chicago.

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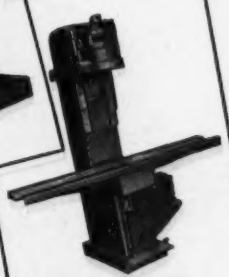

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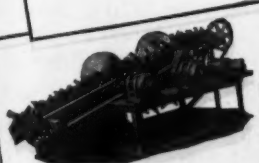

Pulpwood Slashers

Roll Heading Machines

GRID Unit Heater—now made with Cast Iron heating sections.

Cast Iron replaces aluminum in the GRID Unit Heater, to cooperate with the war effort—no electrolysis — made for years of dependable service. Ideal for paper mill heating requirements.

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MISCELLANEOUS MARKETS

Office of the PAPER TRADE JOURNAL.
Wednesday, September 30, 1942.

BLANC FIXE—Prices on blanc fixe are firm and unchanged and conform to prevailing market levels. The pulp is currently quoted at $40 per ton, in barrels, at works; the powder is currently quoted at $60 per ton, f.o.b., works. Demand reported good for the week.

BLEACHING POWDER — Quotations on bleaching powder are firm. Demand reported moderate for the week. Bleaching powder is currently quoted at $2.25 per 100 pounds, in drums, at works.

CASEIN—Prices on casein are unchanged for the current week. Standard domestic casein, 20-30 mesh, is currently quoted at 17½ cents per pound; 80-100 mesh, at 18 cents per pound. All prices in bags, car lots. Argentina casein, 20-30 mesh, at 7½ cents per pound, c.i.f., is nominal. No quotations on French casein.

CAUSTIC SODA—Quotations on caustic soda continue unchanged at prevailing market prices. Demand reported moderate. Solid caustic soda is currently quoted at $2.30 per 100 pounds; flake and ground at $2.70 per 100 pounds, in drums, car lots, at works.

CHINA CLAY—Prices on china clay are firm and conform to prevailing market levels. Demand reported moderate at this date. Domestic filler clay is currently quoted at from $7.50 to $15 per ton; coating clay at from $12 to $22 per ton, at mines. Imported clay is currently offered at from $13 to $25 per long ton, ship side.

CHLORINE—Quotations on chlorine are firm and unchanged. Market strong. Government demand is reported heavy during the current week. Chlorine is currently quoted at $1.75 per 100 pounds, in single-unit tank cars, f.o.b., works.

ROSIN—The rosin market is reported firm for the week with higher prices on some grades. "G" gum rosin is currently quoted at $3.41 per 100 pounds, in barrels, Savannah. "F" wood rosin is currently quoted at $3.41 per 100 pounds, in barrels, New York. Seventy per cent gum rosin size is quoted at $3.63 per 100 pounds, f.o.b., works.

SALT CAKE—Prices on salt cake are firm. Demand fair for the current week. Domestic salt cake is currently quoted at $15 per ton, in bulk; chrome salt cake at $16 per ton. All prices in car lots, f.o.b., shipping point. The quotation of $16 per ton on imported salt cake is nominal.

SODA ASH — Quotations on soda ash are firm and continue to conform to prevailing market levels. Demand reported moderate for the week. Prices on soda ash in car lots, per 100 pounds, are as follows: in bulk, $.90; in paper bags, $1.05; and in barrels, $1.35.

STARCH—Prices on corn starch are reported unchanged for the current week. Pearl is currently quoted at $3.10 per 100 pounds; powdered starch at $3.20 per 100 pounds. All prices in bags, car lots, f.o.b., Chicago.

SULPHATE OF ALUMINA—Quotations on sulphate of alumina are firm. Demand reported light for the current week. The commercial grades are currently quoted at from $1.15 to $1.25; iron free at from $1.75 to $1.85 per 100 pounds. All prices in bags, car lots, f.o.b., works.

SULPHUR—Prices on sulphur are firm and conform to prevailing market levels. Annual contracts are currently quoted at $16 per long ton, f.o.b. mines. Spot and nearby car lots are quoted at $18 per ton.

TALC—Quotations on talc are firm and continue unchanged at prevailing market prices. Domestic talc is currently quoted at from $15 to $21 per ton, at mines. No quotations on imported talc.

MARKET QUOTATIONS

All market quotations, excepting those otherwise designated as official OPA maximum prices, are based on the manufacturers' price level as of October 1-15, 1941; maximum wholesale prices are based on the merchants' maximum prices for stipulated quantities at a quoted price to all customers of a like class, as shown by the merchant's sales records of goods delivered during March, 1942. A merchant's price list in effect in March 1942, showing quotations of actual shipments, will establish the current maximum prices.

Paper

(Delivered New York)

News, per ton—			
Roll, contract	$50.00	@	—
Sheets	58.00	"	—
Kraft—per cwt.—Carload Quantities Zone A, f.o.b. Mill			
Superstandard Wrapping	$5.00	@	—
No. 1 Wrapping	4.75	"	—
Standard Wrapping	4.50	"	—
Standard Bag	4.125	"	—
Tissues— Per Ream—Carlots			
White No. 1	1.12½	"	—
White No. 1 M. G.	1.05	"	—
White No. 1½	1.00	"	—
White No. 2	1.00	"	—
Anti-Tarnish M. G.	.95	"	—
Colored	—	"	—
Kraft	.95	"	—
Manila	.90	"	—
Unbl. Toilet, 1 M.	4.16	"	—
Bleached Toilet	5.70	"	—
Paper Towels Per Case			
Unbleached, Jr.	2.35	"	—
Bleached, Jr.	2.65	"	—
Manila—per cwt.—C. l. f. s			
No. 1 Jute	11.25	@	—
No. 1 Manila Wrapping, 35 lb.	5.50	"	5.75
No. 2 Manila Wrapping, 35 lb.	5.25	"	5.50
Boards, per ton—			
News	*48.00	@	—
Chip	*45.00	"	—
Sgl. Mia. Ll. Chip	*60.00	"	—
White Pat. Coated	*75.00	"	—
Kraft Liners 50 lb.	*60.00	"	—
Binders Boards	84.00	"	116.00

* OPA Base Prices per 10 tons. Less than 10 tons but over 3 tons, add $2.50; three tons or less, add $5. regular 35-39 basis, add $5.; basis 40-49, add $2.50; basis 91-100, add $2.50; basis 101-120, add $5.

The following are representative of distributors' resale prices:

Rag Content Bonds and Ledgers—White, Assorted Items, Delivered in Zone 1:

	Bonds		Ledgers	
100% Rag Ext. No. 1	$40.25	@$47.25	$41.40	@$48.50
100% Rag	32.20	" 37.75	33.35	" 39.25
85% Rag	....	"	32.20	" 37.75
75% Rag	24.75	" 29.00	25.90	" 30.50
65% Rag	....	"	22.80	" 27.75
50% Rag	18.70	" 22.75	19.90	" 24.25
25% Rag	16.40	" 20.00	17.55	" 21.50

Colors at $1.00 cwt. extra.

Sulphite Bonds and Ledgers—White. Assorted Items Delivered in Zone 1:

	Bonds		Ledgers	
No. 1	$10.35	@$12.75	$11.70	@$14.25
No. 2	9.65	" 11.75	10.80	" 13.25
No. 3	9.20	" 11.25	10.35	" 12.50
No. 4	8.90	" 10.75	10.05	" 12.25

Colors $1.00 cwt. extra.

Free Sheet Book Papers—White, Cased Paper.

Delivered in Zone 1

No. 1 Glossy Coated	$13.63	@	$15.50
No. 2 Glossy Coated	12.40	"	14.00
No. 3 Glossy Coated	11.60	"	13.25
No. 4 Glossy Coated	11.15	"	12.75
No. 1 Antique (water marked)	10.25	"	11.75
No. 2. Offset	9.60	"	11.00
A Grade E. F.	9.35	"	10.75
A Grade S. & S. C.	9.60	"	11.00
B Grade E. F.	8.85	"	10.25
B Grade S. & S. C.	9.10	"	10.50
C Grade E. F.	8.55	"	9.75
C Grade S. & S. C.	8.80	"	10.00
D Grade E. F.	8.25	"	9.50
D Grade S. & S. C.	8.50	"	9.75

Ivory & India at $.50 cwt. extra.

Wood Pulp

OPA Maximum Prices and Canadian Manufacturers Prices, Less Freight to Destination.

Bl. Softwood Sulphite	$76.00
Unbl. Softwood Sulphite	64.00@ 66.00
Bl. Hardwood Sulphite	73.50
Unbl. Hardwood Sulphite	63.50
Bl. Mitscherlich	81.00
Unbl. Mitscherlich	72.00
N. Bleached Sulphate	86.00
S. Bleached Sulphate	79.00
N. Semi-Bleached Sulphate	82.00
S. Semi-Bleached Sulphate	75.00
N. Unbl. Sulphate	73.00
S. Unbl. Sulphate	63.50
Bl. Soda	66.00
Unbl. Soda	62.00
Groundwood	46.00

Transportation Allowances

Applying to Producers of Wet Wood Pulp.

	Below 50% Air Dry Weight
Northeast	$13.50
Lake Central	13.50
Southern	16.00
West Coast (in area)	10.50
West Coast (out area)	16.50
	50%-80% Air Dry Weight
Northeast	$11.50
Lake Central	11.50
Southern	14.00
West Coast (in area)	9.50
West Coast (out area)	15.50

Applying to Producers of Dry Wood Pulp.

	Above 80% Air Dry Weight
Northeast	$8.50
Lake Central	8.50
Southern	11.00
West Coast (in area)	7.50
West Coast (out area)	13.50

Should freight charges actually exceed these allowances, the difference may be added to the maximum price.

Domestic Rags

New Rags

(Prices to Mill f. o. b. N. Y.)

Shirt Cuttings—			
New White, No. 1	8.00	@	8.25
Silesias No. 1	4.50	"	4.75
New Unbleached	8.00	"	8.25
Blue Overall	5.75	"	6.00
Fancy	3.00	"	3.25
Washables	2.50	"	2.75
Mixed Khaki Cuttings	2.50	"	2.75
O. D. Khaki Cuttings	3.00	"	3.15

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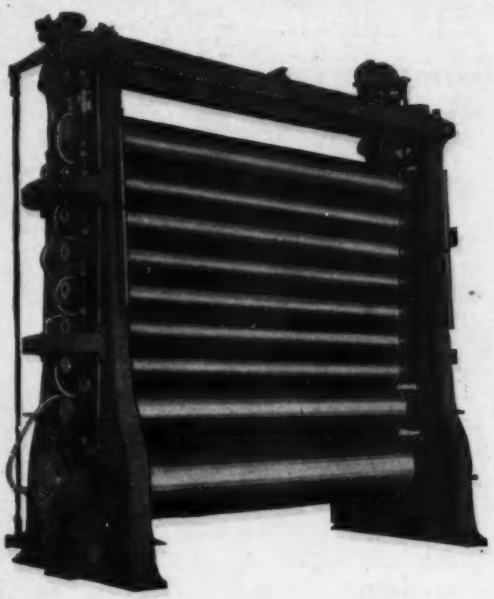

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LOBDELL
COMPANY
107 Years in Business
WILMINGTON · DELAWARE

Old Rags

White, No. 1—			
Repacked	*3.80	"	—
Miscellaneous	*3.20	"	—
White, No. 2—			
Repacked	*2.90	"	—
Miscellaneous	*2.65	"	—
Third and Blues—			
Repacked	*2.20	"	—
Miscellaneous	*1.80	"	—
Roofing Rags—			
No. 1	*1.55	"	—
No. 2	*1.45	"	—
No. 3 (bagging)	*1.35	"	—
No. 4	*1.35	"	—
No. 5A	*1.35	"	—
Old Manila Rope	5.75	"	—

OPA Maximum Prices.

Foreign Rags

All prices nominal

New Rags			
New Dark Cuttings	2.25	@	2.40
New Mixed Cuttings	2.00	"	2.20
New Light Silesias	5.50	"	5.75
Light Flannelettes	5.50	"	5.75
New White Cuttings	7.00	"	7.50
New Light Oxfords	4.00	"	4.50
New Light Prints	3.00	"	3.25
Old Rags			
No. 1 White Linens	7.50	"	8.50
No. 2 White Linens	6.50	"	7.50
No. 3 White Linens	4.50	"	—
No. 4 White Linens	2.25	"	3.25
No. 1 White Cotton	4.25	"	4.75
No. 2 White Cotton	3.25	"	3.75
No. 3 White Cotton	2.50	"	3.00
No. 4 White Cotton	1.90	"	2.20
Extra Light Prints	2.00	"	2.40
Ord. Light Prints	1.75	"	2.15
Med. Light Prints	1.55	"	1.95
Dutch Blue Cottons	2.25	"	2.50
French Blue Linens	3.00	"	—
Checks and Blues	2.00	"	—
Linsey Garments	1.90	"	2.00
Dark Cottons	1.50	"	1.60
Old Shopperies	1.30	"	1.45
New Shopperies	1.45	"	1.50
French Blues	2.25	"	2.50

BAGGING

(Prices to Mill, f. o. b. N. Y.)

Gunny No. 1—			
Foreign	Nominal		
Domestic	4.00	@	4.25
Wool Tares, light	4.25	"	4.50
Wool Tares heavy	4.50	"	4.75
Bright Bagging	4.50	"	4.85
Manila Rope—			
Foreign	—	"	—
Domestic	*5.75	"	—
Jute Threads	4.25	"	4.75
Sisal Strings	3.25	"	3.75
Mixed Strings	1.10	"	1.20

*OPA Maximum Price.

Old Waste Papers

(F. o. b. New York)

OPA Maximum Prices

No. 1 Hard White Envelope Cuts, one cut	3.37½	@	—
No. 1 Hard White Envelope Cuts	3.12½	"	—
No. 1 Hard White Shavings, unruled	2.87½	"	—
No. 1 Hard White Shavings, ruled	2.50	"	—
Soft White Shavings, one cut	2.87½	"	—
No. 1 Soft White Shavings	2.50	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 Fly Leaf Shavings	1.67½	"	—
No. 2 Fly Leaf Shavings	1.12½	"	—
No. 1 Groundwood Fly Leaf Shavings	1.25	"	—
No. 2 Mixed Groundwood Fly Leaf Shavings	.90	"	—
Mixed Colored Shavings	.75	"	—
Mixed Groundwood Colored Shavings	.90	"	—
Overissue Magazines	1.67½	"	—
No. 1 Heavy Books & Magazines	1.57	"	—
Mixed Books	1.07½	"	—
No. 1 White Ledger	2.17½	"	—
No. 2 Mixed Ledger, colored	1.87½	"	—
New Manila Envelope Cuttings, one cut	2.87½	"	—
New Manila Envelope Cuttings	2.65	"	—
Extra Manilas	1.85	"	—
Mixed Kraft, Env. & Bag Cuttings	2.75	"	—
Kraft Envelope Cuttings	3.25	"	—
Triple Sorted, No. 1 Brown Soft Kraft	2.50	"	—
New 100% Kraft Corrugated Cuttings	2.25	"	—
No. 1 Assorted Old Kraft	1.75	"	—
New Jute Corrugated Cuttings	1.75	"	—
Old Corrugated Containers	1.00	"	—
Box Board Cuttings	.72½	"	—
White Blank News	1.65	"	—
Overissue News	.85	"	—
No. 1 News	.75	"	—
No. 1 Mixed Paper	.70	"	—

Twines

(F. o. b. Mill)

(Soft Fiber)

Coarse Polished—			
India	.21	@	—
White Hemp	.21	"	—
Fine Polished—			
Fine India	.36	"	—
Unpolished—			
Box	.17¾	"	—
Paper Makers	.17	"	—
Tube Rope	.19	"	—
Wall Paper	.20½	"	—
Wrapping	.23	"	—
Soft Fiber Rope	.19	"	—
Cotton	.25	"	—
(Hard Fiber)			
Medium Java	.18	"	—
Mex. Sisal	.16	"	—
Manila	—	"	—

PHILADELPHIA

Domestic Rags (New)

(Price to Mill, f. o. b. Phila.)

Shirt Cuttings—			
New White No. 1	.07½	@	.07½
New White No. 2	.04½	"	.05
Light Silesias	.04½	"	.04¾
Silesias, No. 1	.04	"	.04¼
Black Silesias, soft	.03¾	"	.04
New Unbleached	.07¼	"	.07½
Washable Prints	.03¾	"	.03½
Washable No. 1	.02	"	.02¼
Blue Overall	.04½	"	.05½
Cottons—According to grades—			
Washable shredding	—	"	.01¾
Fancy Percales	.03¾	"	.03½
New Black Soft	.02¾	"	.03
New Dark Seconds	1.75	"	2.00
Khaki Cuttings—			
No. 1 O. D.	.03	"	.03¼
No. 2 Mixed	.02¼	"	.02½
Corduroy	.01¾	"	.02¼
New Canvas	.04¾	"	.05¼
New Black Mixed	—	"	.02½

Domestic Rags (Old)

White No. 1—Repacked	3.80	"	—
White No. 2—Repacked	2.90	"	—
Miscellaneous No. 1	3.20	"	—
Miscellaneous No. 2	2.65	"	—
Thirds and Blues—			
Miscellaneous	1.80	"	—
Repacked	2.20	"	—
Black Stockings—(Export)	Nominal		
Roofing Stock—			
Foreign No. 1	Nominal		
Domestic No. 1	1.55	"	—
Domestic No. 2	1.45	"	—
Roofing Bagging	1.35	"	—
Old Manila Rope	5.75	"	—

Bagging

(F. o. b. Phila.)

Gunny No. 1—			
Foreign	Nominal		
Domestic	3.00	"	3.50
Sisal Rope	3.75	"	—
Mixed Rope	.75	"	1.00
Scrap—			
No. 1	3.25	"	3.50
No. 2	1.75	"	1.80
Wool Tares, heavy	4.00	"	4.25
No. 1 New Light Burlap	3.00	"	4.00
New Burlap Cuttings	3.75	"	4.00

Old Papers

(F. o. b. Phila.)

OPA Maximum Prices

No. 1 Hard White Envelope Cuts, one cut	3.37½	"	—
No. 1 Hard White Shavings, unruled	2.50	"	—
Soft White Shavings, one cut	2.87½	"	—
White Blank News	1.65	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 White Ledger	2.17½	"	—
No. 2 Ledger, colored	1.87½	"	—
No. 1 Heavy Books & Magazines	1.57	"	—
Overissue Magazines	1.67½	"	—
New Manila Envelope Cuttings	2.65	"	—
No. 1 Assorted Old Kraft	1.75	"	—
No. 1 Mixed Paper	.70	"	—
Box Board Cuttings	.72½	"	—
Jute Corrugated Cuttings	.90	"	—
Overissue News	.85	"	—
No. 1 News	1.00	"	—

BOSTON

Old Papers

(F. o. b. Boston)

OPA Maximum Prices

No. 1 Hard White Shavings, unruled	2.87½	@	—
No. 1 Hard White Shavings, ruled	2.50	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 Fly Leaf Shavings	1.67½	"	—
No. 2 Fly Leaf Shavings	1.12½	"	—
No. 1 Groundwood Fly Leaf Shavings	1.25	"	—
No. 2 Groundwood Fly Leaf Shavings	.90	"	—
Mixed Colored Shavings	.75	"	—
New Manila Envelope Cuts, one cut	2.87½	"	—
Hard White Envelope Cuts, one cut	3.37½	"	—
Triple Sorted No. 1 Brown Soft Kraft	2.50	"	—
Mixed Kraft Env. & Bag Cuttings	2.75	"	—
Kraft Envelope Cuttings	3.25	"	—
No. 1 Heavy Books & Magazines	1.57	"	—
New Manila Envelope Cuts, one cut	2.87½	"	—
New Manila Envelope Cuttings	2.65	"	—
White Blank News	1.65	"	—
No. 1 Assorted Old Kraft	1.75	"	—
No. 1 Mixed Paper	.70	"	—
Overissue News	.85	"	—
Box Board Cuttings	.72½	"	—
New Corrugated Cuttings, Kraft	2.25	"	—
Old Corrugated Containers	1.00	"	—
Jute Corrugated Cuttings	1.07½	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 White Ledger	2.17½	"	—
No. 2 Ledger, colored	1.87½	"	—
No. 1 Heavy Books & Magazines	1.57	"	—
Overissue Magazines	1.67½	"	—
New Manila Envelope Cuttings	2.65	"	—
No. 1 Assorted Old Kraft	1.75	"	—
No. 1 Mixed Paper	.70	"	—
Box Board Cuttings	.72½	"	—
Jute Corrugated Cuttings	.90	"	—
Overissue News	.85	"	—
No. 1 News	1.00	"	—

Bagging

(F. o. b. Boston)

Gunny Bagging—			
Foreign	(nominal)		
Domestic	4.00	@	4.25
Sisal Rope	4.50	"	4.75
Mixed Rope	1.35	"	1.50
Transmission Rope—			
Foreign	(nominal)		
Domestic	3.00	"	3.50
Manila Rope—			
Foreign	(nominal)		
Domestic	5.75	"	—
Soft Jute Rope	4.50	"	5.00
Jute Carpet Threads	3.00	"	3.50
Bleachery Burlap	8.50	"	9.00
Scrap Burlap—			
Foreign	(nominal)		
Domestic	4.00	"	4.25
Scrap Sisal	4.50	"	4.75
Scrap Sisal for Shredding	4.75	"	5.00
Wool Tares—			
Foreign	(nominal)		
Domestic	5.00	"	5.75
Aust. Wool Pouches	5.00	"	5.25
New Burlap Cuttings	5.00	"	5.25
Heavy Baling Bagging	4.25	"	5.75
Paper Mill Bagging	2.75	"	3.25
No. 2 Bagging	1.35	"	—

*OPA Maximum Price.

Domestic Rags (New)

(F. o. b. Boston)

Shirt Cuttings—			
New Light Prints	.04½	@	.04¾
Fancy Percales	.04¼	"	.05
New White No. 1	.06½	"	.07
New Light Flannelettes	.06	"	.04¼
Canton Flannel, Bleached	.06¾	"	.07
Underwear Cutters, Bleached	.06	"	.06½
Underwear Cutters, Unbleached	.06	"	.06½
Silesias No. 1	.06	"	.06¼
New Black Silesias	.03¾	"	.04
Red Cotton Cuttings	.03¾	"	.04
Soft Unbleached	.07	"	.07¼
Blue Cheviots	.05½	"	.06
Fancy	.02¾	"	—
Washable	.02¾	"	—
Khaki Cuttings	.03½	"	.03¾
O. D. Khaki	.04	"	.04¼
Corduroy	.03¼	"	.03¾
New Canvas	.07	"	.07½
B. V. D. Cuttings	.06½	"	.07

Domestic Rags (Old)

(F. o. b. Boston)

White No. 1—			
Repacked	3.80	@	—*
Miscellaneous	3.20	"	—*
White No. 2—			
Miscellaneous	2.65	"	—*
Twos and Blues, Repacked	2.20	"	—*
Old Blue Overalls	2.25	"	2.50
Thirds and Blues, Repacked	2.20	"	—*
Miscellaneous	1.80	"	—*
Black Stockings	3.50	"	4.00
Roofing Stock—			
No. 1	1.55	"	—*
No. 2	1.45	"	—*
No. 3	1.35	"	—*
No. 4	1.35	"	—*
No. 5, Quality A	1.35	"	—*
Quality B	1.20	"	—*
Quality C	.95	"	—*
Old Manila Rope	5.75	"	—

*OPA Maximum Prices.

Foreign Rags

(F. o. b. Boston)

Canvas	(nominal)
Dark Cottons	(nominal)
Dutch Blues	(nominal)
New Checks and Blues	(nominal)
Old Fustians	(nominal)
Old Linsey Garments	(nominal)
New Silesias	(nominal)

CHICAGO

Waste Paper

(F. o. b. Chicago)

OPA Maximum Prices

Shavings—			
No. 1 Hard White Envelope Cuts, one cut	3.37½	"	—
No. 1 Hard White Shavings, unruled	2.50	"	—
No. 1 Soft White Shavings	2.50	"	—
No. 1 White Ledger	2.17½	"	—
No. 1 Heavy Books & Magazines	1.57	"	—
White Blank News	1.65	"	—
Mixed Kraft Env. & Bag Cuttings	2.75	"	—
No. 1 Assorted Old Kraft	1.75	"	—
Overissue News	.85	"	—
No. 1 News	.75	"	—
No. 1 Mixed Paper	.70	"	—
No. 1 Roofing Rags	1.55	"	—
No. 2 Roofing Rags	1.45	"	—